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InterRidge News

Initiative for international cooperation in ridge-crest studies

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Errata for IR news 11.2, Fall 2002

In the article "Biological studies using "Mir" submersibles..." pp 23-28), a very important reference about the source of the hydrographical data was lost in the captions to the Figs. 1-2. The data were obtained by Dr. D L. Alejnik (Institute of oceanology, Moscow). We use this opportunity to correct the situation and to thank Dr. D L. Alejnik.

The Authors

(A L. Vereshchaka, S.V. Galkin, A.V. Gebruk, E M. Krylova, G M. Vinogradov, and C. Borowski)

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InterRidge Mailing List
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http://www.intridge.org/signup.htm

You can use the online form to join our regular mailing list to receive InterRidge News, or to be put on the electronic directory on the web (http://www.intridge.org). Currently there are over 2800 scientists active in mid-ocean ridge research on our mailing list. We are constantly adding new entries to the electronic directory which contains a listing of each researchers field of interest and expertise as well as their full address information. Links are also provided to personal or departmental web pages.

Coordinator's Update

Upcoming InterRidge meetings

IR Steering Committee meeting

The venue for this year's IR Steering Committee meeting have been changed. During this meeting the final version of the "Next Decade Plan" will be officially approved and the new host Chair for the next term of the IR office will be selected. Just to remind you, the IR office will be moving to a new location with a new Chair and Coordinator at the end of 2003. Bids for hosting the next term of the IR office were sought by the IR office and the final decision about relocation of the office will be made by the InterRidge Steering Committee.

InterRidge Workshop postponed:

"Opportunities and Contributions of Asian Countries to the InterRidge Next Decade Initiative", scheduled to held in Beijing, China, in June, 2003 has been postponed. New dates will be announced in the near future. Meeting co-chairs are John Chen and Jian Lin.

Symposium and Workshop

"Ridge-Hotspot Interaction: Recent Progress and Prospects for an Enhanced International Collaboration". To be held in Brest, France, September 8-10, 2003. Co-chaired by Jerome Dyment and Jian Lin. See the back of this issue for an outline of the objectives of this meeting.

Joint R2K-IR Teoretical institute: Interactions among Physical, Chemical, Biological, and Geological Processes in Backarc Spreading Systems

The second IR theoretical Institute will take place on the Jeju (Cheju) Island, a shield volcanic island, located at the southern end of Korean peninsular, from 24-28th May, 2004.

The IRTI will consist of 2 days of invited lectures and short courses, a one day field excursion, followed by a 2 day workshop devoted to discussions by subgroups.

Please contact the IR office (intridge@ori.u-tokyo.ac.jp) to pre-register your interest in attending.

The InterRidge office

The original IR Science Programme plan will come to an end at the end of this year. The IR office will move to a new Host country under the appointment of a new Chair in January 2004. Based on the bids received, the final decision on the new host for the IR office bids will be made in June.

IR Steering Committee members

Thank you to Chris German, UK representative and Chair of the Global Distribution of Hydrothermal Activity WG, and Dr Dave Christie, USA representative, for their valuable contributions as members of the IR Steering Committee. We welcome Dr Debbie Smith from WHOI as the new USA representative in 2003.

New IR correspondent

We wish to welcome Dr Dietmar Müller, Director of the Sydney Institute of Marine Science, University of Sydney, as the new correspondent for Australia.

Working Groups

The current working group structure will be revised in the "Next Decade Plan", which will be available to the entire community once it is finalised. In the mean time the current IR Working Groups continue to work on finishing their projects and working on their goals.

Past and current information about IR working groups and projects can be found on the IR website: http://www.intridge.org/act2.html

The Next Decade Science Plan

The final draft of the next decade science plan is available for download: http://www.intridge.org/irnd.pdf the plan will be approved during the IR Steering committee meeting this year.

InterRidge website

We are continuing to upgrade and improve our web site to maximise information transfer and make it user friendly. To make our homepage more interactive it is divided into two frames. The latest information about IR meetings, announcements and any other current, ridge related items is now at your fingertips, accessible directly from the left hand side frame on our homepage. The right hand side frame contains the familiar menus with lots of ridge related information. Due to the volume of information on our website a brief outline of what can be found there is available on page 6 of this issue.

Remember, you can always access our home page by simply typing: http://www.intridge.org

The IR databases are unique, they provide an international pool of information about all manner of issues related to mid ocean ridges. The "Global hydrothermal vents database" as well as the "Ridge-Hot Spot Interaction Reference Database" can be searched by conventional method, by typing in search words in any of the fields but also these two databases contain interactive area maps to make searches easier. Thus, you can do your search by location just by clicking on the different areas on the globe. The databases take a lot of work to maintain but we relay on your input to keep them up to date!

As always, any comments and suggestions are welcome and remember that I always like to receive updates and new information about meetings and ridge related cruises, as well as job vacancies and other ridge related bits and peaces of information. A brief summary of what can be found on the InterRidge website is also available at http://www.intridge.org/latest.htm

Agnieszka Adamczewska
InterRidge Coordinator
May 2003

InterRidge Office Updates

InterRidge Publications

The following InterRidge publications are available upon request. Fill out an electronic request from at http://www.intridge.org/act3.html
The most recent reports and meeting abstract volumes are available as downloadable files from the same site.

InterRidge News:

Past issues of InterRidge News, are available starting with the first issue published in 1992 until the present. Information about the research articles published in each issue can be found on the InterRidge website: http://www.intridge.org/irn-toc.htm

The InterRidge News issues published from 2000 (ie. InterRidge News 9.1 and all following issues) are available as downloadable PDF files from the same URL address on the InterRidge website, using Adobe Acrobat 4.0 or later versions.

Workshop and Symposium Abstract Volumes:

A full list of Abstract Volumes available from the IR office can be found on the IR website at the following URL: http://www.intridge.org/act3.html#abs . The latest Abstract Volume additions include:
IR Theoretical Institute: Thermal Regime of Ocean Ridges & Dynamics of Hydrothermal Circulation, pp.84, Sept. 2002.
InterRidge Workshop: MOMAR II (Monitoring the Mid-Atlantic Ridge), pp.24, June 2002
InterRidge Workshop: SWIR (South West Indian Ridge Workshop), pp.79, April 2002.

Workshop and Working Group Reports:

IR MOMAR (MOnitoring the Mid-Atlantic Ridge) workshop report, April, 1999.
IR Mapping and Sampling the Arctic Ridges: A Project Plan, pp.25, December 1998.
ODP-IR-IAVCEI Workshop Rep.: The Oceanic Lithosphere and Scientific Drilling into the 21st Century, pp.89.
IR Global Working Group Workshop Report: Arctic Ridges: Results and Planning, pp.78, October 1997.
IR SWIR Project Plan, pp.21, October 1997 (revised version).
IR Meso-Scale Workshop Report: Quantification of Fluxes at Mid-Ocean Ridges: Design/Planning for the Segment Scale Box Experiment, pp.20, March 1996.
IR Active Processes Working Group Workshop Report: Event Detection and Response & A Ridge Crest Observatory, pp.61, December 1996.
IR Biological Ad Hoc Committee Workshop Report: Biological Studies at the Mid-Ocean Ridge Crest, pp.21, August 1996.
IR Meso-Scale Workshop Report: 4-D Architecture of the Oceanic Lithosphere, pp.15, May 1995.
IR Meso-Scale Project Symposium and Workshops Reports, 1994: Segmentation and Fluxes at Mid-Ocean Ridges: A Symposium and Workshops & Back-Arc Basin Studies: A Workshop, pp.67, June 1994.
IR Global Working Group Report 1993: Investigation of the Global System of Mid-Ocean Ridges, pp.40, July 1994.
IR Global Working Group Report 1994: Indian Ocean Planning Meeting Report, pp.3, 1994.
IR Meso-Scale Working Group Meeting Report, Cambridge, UK, pp.6, 1992.

Steering Committee and Program Plan Reports:

IR STCOM Meeting Report, Sestri Levante, Italy, 2002.
IR STCOM Meeting Report, Kobe, Japan, 2001.
IR STCOM Meeting Report, WHOI, USA, 2000.
IR STCOM Meeting Report, Bergen, Norway, 1999.
IR STCOM Meeting Report, Barcelona, Spain, 1998.
IR STCOM Meeting Report, Paris, France, 1997.
IR STCOM Meeting Report, Estoril, Portugal, 1996.
IR STCOM Meeting Report, Kiel, Germany, pp.22, 1995.
IR STCOM Meeting Report, San Francisco, USA, 1994.
IR STCOM Meeting Report, Tokyo, Japan, 1994.
IR STCOM Meeting Report, Seattle, USA, pp.6, 1993.
IR Meeting Report, York, UK, 1992.
IR Meeting Report, Brest, France, pp.39, 1990.
IR Program Plan Addendum 1997, pp.10, Jan. 1998.
IR Program Plan Addendum 1996, pp.10, April 1997.
IR Program Plan Addendum 1995, pp.10, 1996.
IR Program Plan Addendum 1994, pp.15, 1995.
IR Program Plan Addendum 1993, pp.9, 1994.
IR Program Plan, pp.26, 1994.

InterRidge Website

http://www.intridge.org/

The InterRidge office devotes a considerable amount of effort into maintaining an extensive web site with updated information as it comes into the Office. Our website also provides you with various ridge related information including upcoming meetings, scheduled ridge related cruises, job vacancies as well as 9 different databases. These databases on the InterRidge website were initiated in response to a request by the international community to have a 'centralised' clearing house for information collected by scientists all over the world so that relevant information is readily available to everybody at one site. A brief summary of what can be found on the InterRidge website is available at:
http://www.intridge.org/latest.htm

We are pleased that the use of the InterRdige website is steadily increasing and we continue to encourage you make use of this resource and to continue to submit the latest information to our office. To make our homepage more interactive we have divided it into two frames. On the left hand side frame you now have at your fingertips the latest information about meetings, announcements and any other current, ridge related items. The right hand side frame contains the familiar menus, the general contents of which are outlined below. As always any comments and suggestsions are always welcome.

The alias for the IR website makes the URL easy to remember, you can now access the InterRidge home page by simply typing http://www.intridge.org

1) Information section

This section provides links to Ridge related meetings, cruises and other miscellaneous information, as well as a little bit about InterRidge structure and its role, including: Latest ridge related News; an introduction to what is InterRidge, with a short description of the InterRidge programme, outlining the objectives of the programme as well as management structure and national membership of InterRidge; as well as a calendar of international conferences, meetings and workshops.

2) Activities section

This section is concerned with the scientific and management structure of InterRidge. The 'Activities' section includes an outline of the scientific purpose of InterRidge. A description of the activities of the IR working groups, which are responsible for directing different aspects of ridge research with updates of their activities can be found here. You can also find links to major projects that InterRidge is currently involved in and projects that are directly relevant to InterRidge activities - such as MOMAR and the Marine Protected Areas project. Additionally, in this section, you can find a list of all the publications distributed by the InterRidge office as well as a list of the InterRidge National Correspondents, and their contact details, from all of our Member Nations.

3) InterRidge databases section

One of the major objectives of InterRidge is to facilitate the advancement of ongoing work of individuals, national and international groups by providing centralised information and data-exchange services. Thus, we maintain a number of databases that contain data submitted from Ridge scientists from around the world. We rely on contributions from individuals to continually update the information and increase the number of records. I would like to take this opportunity to encourage everyone to become familiar with the databases on our website and contribute information on a regular basis to ensure that this important resource contains current and up to date information. A list of the databases maintained by InterRidge with a brief introduction can be found on our web site at: http://www.intridge.org/data1.html

The IR office also maintains a database with contact details of scientists involved in ridge reserach. We are slowly building this database and it is still incomplete.

Furthermore, there is a neat little program, which you can use to calculate the spreading rate of the sea floor at any place around the globe!

Hydrothermal Ecological Reserves Page:
http://www.intridge.org/reser-db.htm

This page lists all the current ecological reserves that have been proposed at hydrothermal vents. These vary in breadth and scope; at Juan de Fuca the Canadian government has proposed the Endeavour vent field as a pilot marine protected area, while other reserves consist of requests from individual scientists conducting experiments in specific areas. There is also an on-line form to submit reserves to the page.

InterRidge Office Updates

Overview of InterRidge Working Groups

Below is a summary of the current WG structure. More information on these working groups can be found on our website: http://www.intridge.org/act2.html

The Next Decade plan of InterRidge will come into effect from next year and new working groups will be formed.

Arctic Ridges
Objective: Coordinate planning efforts for mapping and sampling the Arctic Ridges.
Chair: Colin Devey (Germany)
WG members: G.A. Cherkashov (Russia), B.J. Coakley (USA), K. Crane (USA), O. Dauteuil (France), V. Glebowsky (Russia), K. Gronvold (Iceland), H.R. Jackson (Canada), W. Jokat (Germany), Y. Kristoffersen (Norway), P. J. Michael (USA), K.J. Young (Korea), N.C. Mitchell (UK), H.A. Roeser (Germany), H. Shimamura (Japan), Y. Nogi (Japan), C.L. Van Dover (USA).

Back-Arc Basins
Objectives: Summarise past work on Back-Arc Basins and coordinate future studies.
Chair: Sang-Mook Lee (Korea)
WG members: Ph. Bouchet (France), J.-L. Charlou (France), K. Fujioka (Japan), E. Grácia (Spain), P. Herzig (Germany), J. Ishibashi (Japan), Y. Kido (Japan), S-M. Lee (Korea), R. Livermore (UK), S. Scott (Canada), R. J. Stern (USA), K. Tamaki (Japan), and B. Taylor (USA).

Biological Studies
Objectives: Objectives of the New biology WG are outlined on the IR website.
Chairs: Franocise Gaill (France) and S. Kim Juniper (Canada).
WG members: M. Biscoito (Portugal), O. Gierre (Germany), J-H Hyun (S. Korea), A. Metaxas (Canada) T. Shank (USA), K. Takai (Japan), P. Tyler (UK) and F. Zal (France)

Global Digital Database
This working group has finished its activities.
Last chair: Phillippe Blondel (UK)
WG members: J.S. Cervantes (Spain), C. Deplus (France), M. Jakobsson (Sweden), K. Okino (Japan), M. Ligi (Italy), R. Macnab (Canada), T. Matsumoto (Japan), K.A.K. Raju (India), W. Ryan (USA), and W. Weinrebe (Germany).

Global Distribution of Hydrothermal Activity
This working group has finished its activities.
Last chair: Chris R. German (UK)
WG members: E. Baker (USA), Y.J. Chen (USA), D. Cowan (UK), T. Gamo (Japan), E. Grácia (Spain), P. Halbach (Germany), S.-M. Lee (Korea), G. Massoth (N.Z), J. Radford-Knoery (France), A-L. Reysenbach (USA), D.S. Scheirer (USA), S.D. Scott (Canada), K.G. Speer (USA), C.A. Stein (USA), V. Tunnicliffe (Canada) and C.L. Van Dover (USA).

HotSpot-Ridge Interactions
Objectives: This WG was formed during the 2000 Steering Committee meeting to promote and facilitate global research to better understand the physical and chemical interactions between mantle plumes and mid-ocean ridges and their effects on seafloor geological, hydrothermal, and biological processes.
Chairs: Jian Lin (USA) and Jerome Dyment (France)
WG members: R.K. Drolia (India), J. Escartín (France), J. Freire Luis (Portugal), E. Grácia (Spain), D.W. Graham (USA), K. Hoernle (Germany), G.T. Ito (USA), B. Murton (UK) N. Seama (Japan), F. Sigmundsson (Iceland)

Monitoring and Observatories
Objectives: Develop detection methods of transient ridge-crest seismic, volcanic and hydrothermal events, and the logistical responses to them.
Chairs: Javier Escartin (France) and Ricardo Santos (Azores, Portugal)
WG members: Chris Fox (USA), K. Mitsuzawa (Japan), Pierre-Marie Sarradin (France), Adam Schultz (UK), Paul Snelgrove (USA), Paul Tyler (UK).

SWIR
This working group has finished its activities.
Last chair: Catherine Mével (France)
WG members: M. Canals (Spain), C. German (UK), N. Grindlay (USA), C. Langmuir (USA), A. Le Roex (South Africa), C. MacLeod (UK), J. Snow (Germany), T. Kanazawa (Japan) and C.L. Van Dover (USA).

Undersea Technology
This working group has finished its activities.
Last chair: Spahr C. Webb (USA)
WG members: J.R. Delaney (USA), H. Momma (Japan), J. Kasahara (Japan), M. Kinoshita (Japan), A. Schultz (UK), D.S. Stakes (USA), P. Tarits (France) and H. Villinger (Germany).

Updates on InterRidge Projects

Monitoring and Observatories Working Group

Javier Escartin (IPGP/CNRS, Paris, France) AND
Ricardo Serrão Santos (DOP, U of Azores, Horta, Portugal)

The last 12 months have seen considerable effort towards long-term monitoring of the MOMAR area at the Mid-Atlantic Ridge. These are continuing at the present time, as summarised below:

II MOMAR Workshop

The II MOMAR Workshop (15-17 June 2002, Horta, Azores), convened and organised by the Monitories and Observatories Working Group, was successfully carried out. A complete report of this Workshop is available at: http://www.ipgp.jussieu.fr/~escartin/MOMAR, together with open access to background data on the area. These data where compiled immediately after one of the meeting's recommendations (additional data contributions are welcome). This Workshop was coordinated and immediately followed by the 'Vents Management Workshop' (18-21 June 2003); the final report is available at: http://www.horta.uac.pt/VentManagement. These Workshops established the basic experimental priorities and the basis for site management during long-term observations.

6th European Framework Program

The 6th European Framework program was announced at the end of 2002, and strongly determines the strategy to follow in the European arena towards the implementation of MOMAR. In a meeting in Lisbon in December 2002 it was decided to postpone the preparation of a MOMAR Integrated Project under the 6FP, as this project was not contemplated in the first call for proposals. A proposal to establish a European-wide network will be submitted to the European Union on the 2nd of April, coordinated by M. Cannat (IPGP/CNRS, France). This network targets mobility and training of personnel around the MOMAR project, but proposals in future European will be put forward for the implementation of long-term and observatory observations. These efforts also reflect an important coordination of European Laboratories and scientists with interest in the MOMAR project.

Seismic Monitoring of the MAR

The North-Atlantic Hydrophone array was deployed in March 1999 and will be in place till 2006 (D. Smith, WHOI, M. Tolstoy, LDEO, H. Matsumoto, OSU, and C. Fox, NOAA/PMEL). These instruments recorded a seismic crisis in 03/2001 over the Lucky Strike segment, one of the main targets of the MOMAR project. This array was complemented with additional hydrophones from the SIRENA project (INSU/CNRS, J. Goslin, UBO, S. Bazin, IPG, and C. Fox, NOAA/PMEL) that will be deployed to the north of the Azores. Both arrays will allow monitoring of a large portion of the Mid-Atlantic Ridge (~10°-50°N), including the MOMAR area.

ESF Exploratory Workshop

The European Science Foundation has funded an Exploratory Workshop on 'Long Term Monitoring of Hydrothermal Ecosystems' that will take place in Barcelona, Spain, on 15-17 October 2003. The meeting, which will be limited to ~20-30 participants, will be announced shortly to call for applications from potential participants. Applications will be selected so as to assure equilibrium in the expertise and national representation, following the recommendations of the ESF.

Information on the activities of InterRidge Working Groups can be found on the IR web site under the menu "Projects & WG" or by going directly to:

http://www.intridge.org/act2.html

The abstracts volume and the workshop report from the II MOMAR workshop are avilable from:

http://www.intridge.org/act3.html

Updates on InterRidge Projects

Biology Working Group

A Code of Conduct to Conserve and Sustainably Use Hydrothermal Vent Sites

S. Kim Juniper (Canada) and Lyle Glowka (Germany)

The InterRidge Biology Working group, co-chaired by Kim Juniper (Canada) and Françoise Gaill (France), in collaboration with environmental lawyer Lyle Glowka (Germany), is developing a Code of Conduct for the sustainable use of hydrothermal vent sites by researchers and tour operators. A draft document will be presented to the InterRidge Steering Committee at its annual meeting in June 2003 in Tokyo. The Steering Committee will be asked to provide feedback on the document, so that the Code recognises the requirements of the research community as well as the need for conservation and protection measures. It is our ultimate goal that this Code of Conduct be adopted by InterRidge and national programs and agencies involved in mid-ocean ridge research. In this article we present the reasoning behind the development of the Code of Conduct and provide an update on the elements that it will likely contain.

The Problem

The more accessible hydrothermal vent sites in the world's oceans, both within and beyond the limits of national jurisdiction, are potentially threatened by human activities. Activities most likely to involve hydrothermal vent systems and their associated biological communities are seabed mining for associated polymetallic sulphide deposits, submarine-based tourism (SBT) and marine scientific research (MSR).

Of these, MSR and SBT pose the most immediate threat to hydrothermal vent systems and their associated biological communities. Use conflicts are also increasingly common. As natural resource-based activities MSR and SBT need to be placed on a sustainable footing in order to conserve biodiversity, maintain the scientific value of the most accessible sites and to minimise conflicts.

Why a Code of Conduct?

With limited exceptions, at present, international and national legal frameworks do not offer definitive tools to place MSR and SBT activities on a sustainable basis and to minimise use conflicts at hydrothermal vent sites. Therefore the user community – the marine scientific research community and tour operators – should take the lead in ensuring conservation and sustainable use and minimising use conflicts.

A code of conduct could have a supporting role to play in jurisdictions where national legislation already exists for vessel clearance, marine scientific research or conservation measures such as marine protected areas. A code could be applied, either as an intermediate step towards the application of more detailed rules or to supplement the application of existing legislation.

A code of conduct may also be useful in situations where MSR and SBT activities involve hydrothermal vents in jurisdictions where no national legislation exists or is planned. By this logic a code could also be applied to activities within the International Seabed Area beyond limits of national jurisdiction.

Voluntary approaches within the user community involving a code of conduct along with self- and peer policing, could be the most expeditious way to minimise the environmental impacts and conflicts that MSR and SBT activities may pose to hydrothermal vents and their associated biological communities. The need for further regulatory measures at international or national levels could be averted if they were widely adopted and applied.

The Code: Its Content and Format

We are proposing that the Code will consist of a concise statement of principles applicable to MSR and SBT activities, followed by a corresponding set of Operating Guidelines applicable to organisations and individuals operating generally. They could be adapted and applied at specific sites as well. The Guidelines could function as benchmarks against which to judge the performance of the organisations undertaking marine scientific research, their affiliated researchers and tour operators. They could provide principles with which to develop institutional environmental management systems. They may also provide principles for regulatory agencies developing or applying vessel clearance and other regulatory procedures or conservation measures such as marine protected areas.

Development of the Code

Elements of the code are being drawn from a number of different sources. The report of the InterRidge Workshop on the Management and Conservation of Hydrothermal Vent Ecosystems provided important principles related to MSR activities. Another important source was the Workshop on the Azores Triple Junction Hydrothermal Vents Marine Protected Area Management Plan.

A number of elements draw heavily from or are identical to the Code

Updates on InterRidge Projects

for Environmental Management of Marine Mining, developed by Dr. Derek Ellis for the International Marine Minerals Society (IMMS), and adopted by the IMMS on 2 November 2001.

Finally, the Code will reflect the comments and experience of researchers, environmental lawyers and tour operators through a process of review, comments and editing from March 2003.

To whom would the Code apply?

The Code could apply to organisations and affiliated individuals undertaking MSR and SBT activities at hydrothermal vents located within and beyond the limits of national jurisdiction.

How would the Code function?

The Code's application would be voluntary. The Code would provide a framework and benchmarks for implementation by national research programs, and by extension to their affiliated or sponsored individual researchers, and tour operators. The principles embodied in the Code could provide the basis for institutional codes of conduct and environmental management systems. The Code's framework and benchmarks could provide the basis for stakeholders in government, NGOs and communities to appraise actual and intended conduct at hydrothermal vent sites.

In the context of MSR, funding agencies and project or peer review committees could use the Code as part of their tool-kit of screening criteria against which to judge the merits of a proposed project. Post-project reporting could demonstrate the extent to which the Code was complied with. Compliance with the code could be used in considerations for future funding.

Research organisations and tour operators adopting the Code or following its Principles and Operating Guidelines would be encouraged to publicise their actions.

Basic Principles

The operation guidelines of the code would be developed around 4 basic principles.

Organisations and individuals undertaking MSR and SBT activities adopting the Code of Conduct commit themselves to:

1) Identify and comply with international, national and sub-national laws and policies;
2) Minimise or eliminate adverse environmental impacts through all stages of an activity;
3) Minimise or eliminate actual or potential conflicts or interference with existing or planned MSR activities; and
4) Monitor, evaluate and report on the Code's application.

Code Review

It is intended that the InterRidge Steering Committee would review the Code after five years, with a focus toward possible amendments based on experience with its implementation. A consultation with national programs and the tourism industry as well as other stakeholders involved with hydrothermal vent sites is envisioned.

We welcome feedback from the InterRidge community at all points in the process of drafting and discussion of the code.

Biology Working Group web page
http://www.intridge.org/wg-bio.htm

Hydrothermal Vent Management Workshop Report
http://www.intridge.org/ventrep.pdf

Vent Reserves web page
http://www.intridge.org/reserve.htm

Database of Biological Samples web page
http://www.intridge.org/samp-db.htm

Sample Exchange Agreement web page
http://www.intridge.org/samp-exc.htm

Updates on InterRidge Projects

Proceedings of the second International Symposium on Deep-Sea Hydrothermal Vent Biology

Brest, France October 8-12, 2001

Editors, Kim Juniper and Daniel Desbruyères

The Second International Symposium on Deep-Sea Hydrothermal Vent Biology was held in Brest, France, from October 8-12, 2001. Following the symposium, 46 of the contributed papers were peer-reviewed and published in Cahiers de Biologie Marine. The Table of Contents is presented below. A limited number of Proceedings volumes are available for purchase (70 Euros plus postage) through either of the two Guest Editors, according to your region.

Guest Editors
Kim Juniper (Americas, Pacific),
Université du Québec à Montréal, Montréal, Québec, Canada

Daniel Desbruyères (Eurasia, Africa)
IFREMER, Centre de Brest, Brest, France

Cahiers de Biologie Marine 2002, Volume 43 n°3-4

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16. Faunal succession on replicate deep-sea whale falls: Time scales and vent-seep affinities. Craig R. SMITH, Amy R. BACO and Adrian G. GLOVER., pp 293-297

17. Behavioural observations of the cephalopod Vulcanoctopus hydrothermalis. Francisco ROCHA, Ángel F. GONZÁLEZ, Michel SEGONZAC and Ángel GUERRA, pp 299-302

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21. Hydrothermal vent microbial communities: a fossil perspective. Crispin T. S. LITTLE and Ingunn H. THORSETH, pp 317-319

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International Research: Mid-Atlantic Ridge

New discoveries at 12°58'N, 44°52'W, MAR: Professor Logatchev-22 cruise, initial results

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A new active hydrothermal field with massive sulphide deposits was discovered at 12°58.4'N, 44°51.8'W, near the Marathon Fault, Mid Atlantic Ridge (MAR). It is located on the western slope of the rift valley, at depths of 4000-4100 m, and is hosted by peridotites.

Hydrothermal signals have recently been recorded from the bottom waters in this area during the cruises of R/V Professor Logatchev (Bel'tenev et al., 2002), R/V Yuzhmorgeologiya (Sudarikov et al., 2001) and R/V Atlantis (Sudarikov and Zhirnov, 2001).

This site was revisited in February 2003 on the 22nd cruise of the R/V Professor Logatchev, organised by the Polar Marine Geosurvey Expedition in association with VNIIOkeangeologia (St. Petersburg, Russia). In the beginning of the cruise extremely high anomalies of turbidity, temperature and dissolved manganese in the water column were detected. The vertical distribution of turbidity exhibits a bimodal anomaly, with two hydrothermal signals recorded between 3780-3870 m (Bel'tenev et al., 2002), and between 3920-3990 m (Sudarikov et al., 2001). The turbidity in the first layer is 0.031-0.040 NTU (5-7 times higher than background values) and the local maximum turbidity in this layer is 0.254 NTU, found between 3840-3850 m. In the second layer turbidity is 0.034-0.044 NTU. Both layers are characterised by local anomalies of temperature and salinity. There were also high concentrations of dis-

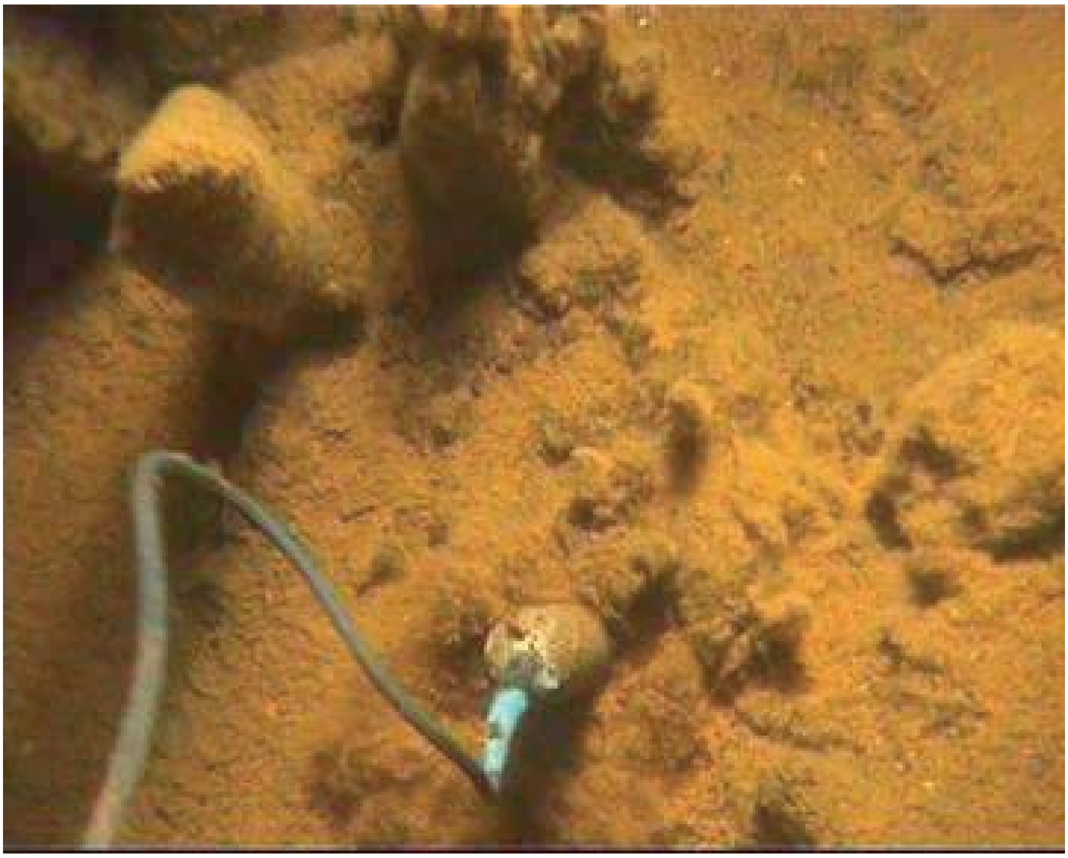

Figure 1. Inactive chimneys.

International Research: Mid-Atlantic Ridge: Beltenev et al., cont...

solved manganese detected: 4 and 8 times higher than background values in layers 1 and 2, respectively. These data confirm the presence of hydrothermal plumes.

As a result of bottom sampling more than 150 kg of massive sulphides were recovered by dredge and TV-grab within this anomalous zone. Some chimney fragments (Fig.1), breccias and peridotites with sulphide mineralisation were dredged at the first station. Onboard analysis showed that sphalerite is the major sulphide mineral and minor minerals are pyrrhotite, chalcopyrite-isocubanite and pyrite. The samples of massive sulphides exhibit spotted texture: the matrix consists of fine-grained sphalerite and spots are composed of chalcopyrite, isocubanite and pyrrhotite. The chimneys also exhibit mineralogical zoning with pyrrhotite and chalcopyrite-isocubanite in the inner and sphalerite in the outer part.

Images of the seafloor were taken using a TV towing system (Fig.2 a,b). Based on preliminary estimates, the hydrothermal field extends for more than 200 m along a N-S traverse. Biota seen on some of the images might well be indicative of hydrothermal environment. In particular, one image (Fig.2b) shows an aggregation of anemones and tubes resembling chaetopterid polychaete tubes. Both organisms are typical of the periphery of MAR hydrothermal fields south of the Broken Spur. They are most common at TAG and Snake Pit hydrothermal sites, and generally occur at a distance of several tens of meters from active vents. Aggregations of fauna seen on the images are uncommon in the regular deep-sea environment at these depths.

More detailed information about this hydrothermal field will be published after the end of the cruise.

Figure 2a. Hydrothermal fauna, at depth 4000-4100 m

Figure 2b. Hydrothermal fauna, at depth 4000-4100 m

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International Research: Mid-Atlantic Ridge

Petromagnetic studies of peridotites and magnetic modelling of seamounts: Investigations

A. M. Gorodnitsky, K. V. Popov, Y. V. Brusilovsky, S. V. Lukjanov, and A. N. Ivanenko

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Petrographic and petromagnetic studies of a collection of peridotites from various localities on the Mid-Atlantic Ridge

We present petromagnetic characteristics of 26 samples from 14 localities near the axis of the Mid-Atlantic Ridge (Fig. 1), collected on the cruises of the R/V Akademik Boris Petrov and the R/V Faranaut (samples collected by the manned submersible Nautile). Our study of the present collection shows strong correlation between peridotites that experienced extensive medium-temperature metamorphic recrystallisation. These samples are characterised by broadly variable contents of the magnetic phase at a rather large grain size value corresponding to ~ 20 microns. Overall, the increase in the degree of serpentinisation of the rocks during mesh serpentinisation is accompanied by a moderate increase in the abundance of the magnetic phase. The relative size of magnetic grains is small, averaging ~3 microns. The size of the magnetic grains increases somewhat with the degree of serpentinisation. Rocks with an increased degree of medium-temperature recrystallisation occasionally exhibit an increased size of magnetic grains. Increased mean sizes of magnetic grains, just as in rocks with green serpentines, are detected only in rocks with intensive (over 25%) manifestation of medium-temperature metamorphic recrystallisation. Therefore, the mean grain size of the magnetite that is formed at various stages of serpentinisation of oceanic peridotites is 1-7 microns. The increase in magnetite content with the degree of rock serpentinisation and with the transition to subsequent serpentinisation stages involves no perceptible change in the mean integrated size of magnetite grains in the rocks. The data obtained suggest that the origin of magnetisation in oceanic peridotites is due not only to their serpentinisation, but also due to inherited magnetic characteristics derived from preceding medium-temperature metamorphism of the rocks. Hence, the thickness of the lithospheric magnetic layer beneath MOR axes is constrained not by the depth of the 350-400° C isotherm, as is assumed in the current petromagnetic models for the structure of oceanic lithosphere, but by the 580° C isotherm. The depth of this isotherm in axial MOR regions, according to geothermal gradient estimates (Bazylev and Silantiev, 2002), may range from 6 to 15 km. This suggests that the uppermost layer of the lithospheric mantle beneath MORs should also be included in the MOR magnetic layer. This suggests that medium-temperature metamorphism of oceanic peridotites may be a factor influencing the formation of the linear magnetic anomalies in the oceanic lithosphere.

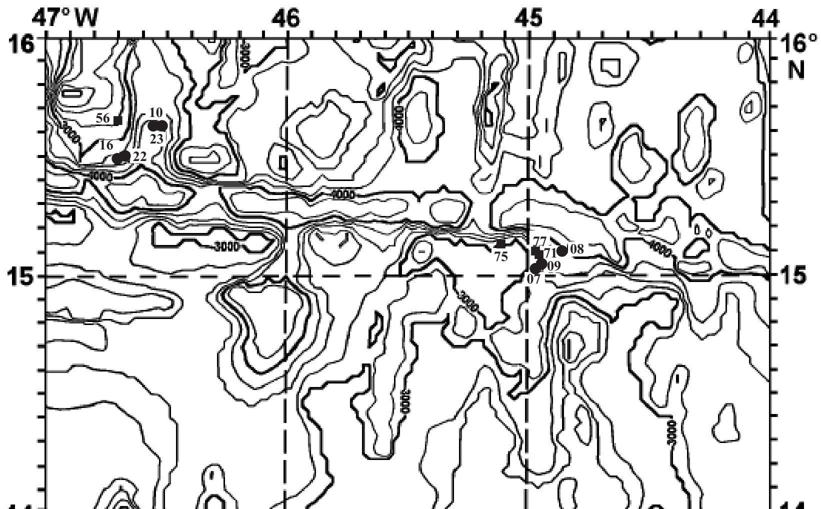

Figure 1. Location of dredge stations (1) and submersible sampling sites (2) along the 15°20'N Fracture Zone, Mid-Atlantic Ridge.

Conclusions

Magnetisation in MOR peridotites takes its origin not only from serpentinisation but also from preceding medium-temperature recrystallisation. The grain size of the magnetite that is formed at various stages of serpentinisation of oceanic peridotite averages 3-4 microns. For the lower boundary of the magnetic layer of oceanic lithosphere, one should adopt the depth of the 580° C isotherm, corresponding to the Curie point for magnetite. Accordingly, the

International Research: Mid-Atlantic Ridge: Gorodnitsky et al., cont...

thickness of this layer in MOR axial regions may reach 15 km.

Magnetic modeling and the analysis of the magnetic field of late cenozoic volcanoes in the northern Kuril islands

An analysis of an abnormal magnetic field of three Late Cenozoic volcanoes located in the northern part of the Kuril Island Arc was carried out with the purpose of division of an anomalous magnetic field into components connected with different depths of field sources. Data from detailed geomagnetic surveys obtained during the cruises of the R/V Vulkanolog were used for this purpose. A computer program (SAPFIR, developed at the IO-RAS by A. N. Ivanenko) was used for the analysis of magnetic fields. This software allows transformation and spectrum analysis of magnetic data. All analyses are carried out in interactive mode and are based on 2-D fast Fourier transformation, allowing rapid consideration and choice of realistic variations in magnetic parameters. The analysis of the magnetic field of these volcanoes consisted of reduction of an initial field to a pole representing magnetic declination (-6°) and inclination (60°) corresponding to the modern location of these volcanoes. After the reduction to a pole a number of transformations were executed and the spectra of initial fields were calculated. Maps of anomalous magnetic fields of three volcanoes were used for the analysis: Volcano 1.4, the Edelshtein Volcanic Complex, and Volcano 3.18. The analysis showed the high efficiency of the technique and allowed us to conclude that the deep character of magnetic anomaly sources is probably related to deep eruption channels for Volcano 1.4, while local extremes are related to internal structural heterogeneity of this volcano. The basic contribution into magnetic field above the Edelshtein Volcanic Complex reveals that this structure was formed on a deep, northeast trending fault. For the submerged Volcano 3.18, the significant contribution to the observable field relates directly to the top part of a cone, with a significant component related to the deep roots of the volcano. The age of all three volcanoes does not exceed 0.7ma.

Acknowledgements

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Tectonics of the ocean floor of the Central and South Atlantic: structural, compositional and metallogenic heterogeneities; their correlation and geodynamic consequences.

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Investigation of the structural and compositional heterogeneities of the Earth's crust, specifically related to the magmatism and geodynamics of the Atlantic Ocean, was conducted by the Geological Institute, RAS in 2000 - 2002. Different regional and local structural and compositional heterogeneities were described in the Atlantic Ocean. It was shown that regional heterogeneities are connected with plumes and local heterogeneities related to both redistribution of mantle material and to the interaction of tectonic, magmatic and metamorphic processes in oceanic lithosphere. A model of the formation of mantle compositional heterogeneity at the initial stages of rifting of the Central Atlantic was proposed. A final monograph was prepared and published (Peyve, 2002).

The first monographic description of South Atlantic tectonics was completed and published (Puscharovsky, 2002). It includes analyses of the characteristics of the tectonic structure of the Mid-Atlantic ridge, ocean basins, positive tectonic structures of the oceanic floor, fracture zones and continental margins. The tectonic history of each of the individual structural elements was analysed.

A synthesis of investigations of tectonic layering of the Atlantic and Indian Ocean lithosphere was prepared (Raznitsin, in press).

A newly explored area in the rift zone of the Mid-Atlantic ridge (6°N) where massive and vein-impregnated sulphide mineralisation was found, resulting in several recent publications (e.g. Puscharovsky et al., 2002). Fragments of cuprum-pyrite ores were sampled during the 10th expedition of the R/V Akademic Ioffe in 2001. Search criteria for hydrothermal sites and for sulphide mineralisation accompanying hydrothermal processes were worked out.

Studies of Fe-Mn crusts collected in the Sierra Leone area (5°-7°N) were completed (Bazilevskaya and Skolotnev, 2002). Direct connection between variations in crust composition and position of samples relative to metal bearing hydrothermal manifestations was established. This was proposed as a new search criteria for determining the location of metal-bearing hydrothermal systems. A corresponding paper was published.

A synthesis of comparative tectonics and deep structure of the Earth's crust in the basins of the northern part of the Central Atlantic was prepared (Puscharovsky and Neprochnov, 2003). New data regarding geological composition and ore distribution were collected during an expedition to the Equatorial Atlantic (5°-7°N) and to the Mid-Atlantic Ridge (20°S) (Skolotnev et al., in press).

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International Research: Back Arc Basins

The break-up of a submarine volcano in the Flores-Wetar Basin (Indonesia): Implications for hydrothermal mineral deposition

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Abstract

The "BANDAMIN I" research cruise in 2001 focused on recent to subrecent hydrothermalism on the seafloor in the Flores-Wetar Basin of eastern Indonesia. Here, a tectonically active area was examined bathymetrically and by rock and water sampling. The study revealed a southeast trending ridge-like submarine structure that can be extended to the subaerial Komba volcano (Batu Tara) which is located northwest of the research area. The "ridge" is cross-cut by a number of subparallel faults that also strike NW-SE. Apparently, an initial seamount structure was cut by a left-lateral transcurrent fault, resulting in two submarine summits with an intervening z-shaped plain (pull-apart structure). The collected rock samples are potassium-rich porphyritic volcanics ranging between basaltic trachyandesites and trachydacites. The rocks vary from fresh to highly altered; the latter are also increasingly impregnated with sulphides. Pyrite is by far the most common sulphide mineral, while pyrrhotite and chalcopyrite are much more rare. Extremely oxidized ore material in the form of gossan samples were also recovered. The volcanics display three major stages of evolution, characterised by their respective SiO_2 and MgO variation: a) early magmatic evolution is marked by initially high Mg contents followed by a steep decrease, b) advanced magmatic evolution in the range from intermediate to felsic rocks shows a moderate MgO decrease, while c) the alteration is characterized by low MgO levels and increasing SiO_2 contents. The chemistry and mineralogy of the altered rocks strongly resembles the type of alteration halo characteristic of epithermal low-sulphidation metal deposits.

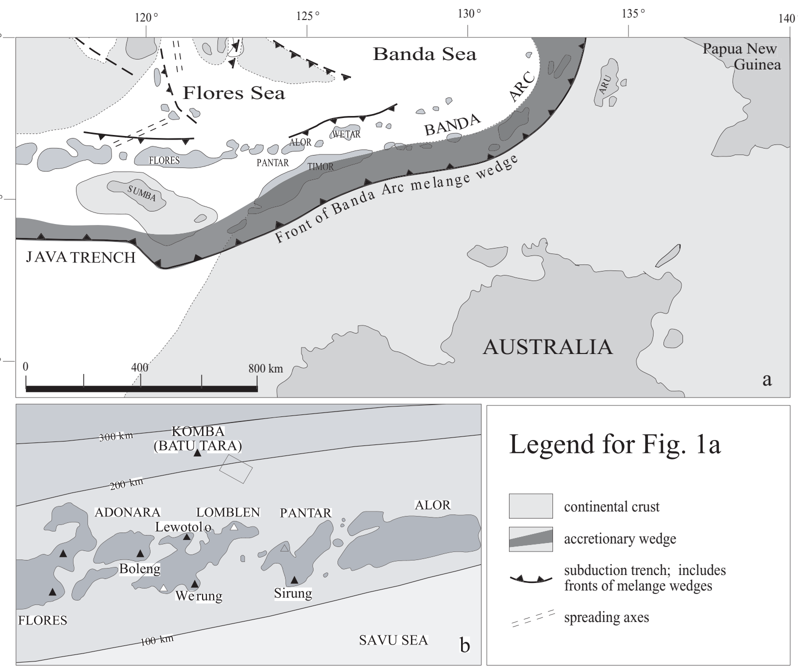

Figure 1. (a) Location map showing the tectonic setting of the eastern Indonesian volcanic arc. (b) Detailed location map showing the islands between Alor and Flores, and the area of investigation (grey box).

Introduction and Regional Geological Setting

The BANDAMIN I cruise (November 2001) on board the Indonesian research vessel BARUNA JAYA IV to the Flores-Wetar Basin comprised a detailed bathymetric study, seafloor sampling (dredge and grab), and water column measurements (CTD combined with rosette water sampler). Our investigations aimed at the identification/localisation of a hydrothermally active area in the basin.

The southern part of Indonesia is characterised by a large island-arc subduction–collision system (Sunda-Banda island-arc), resulting from a complex plate tectonic situation in which three major plates (Pacific, Eurasian, and Indian-Australian Plate) collide with each other (Hamilton, 1979; see also Fig. 1). The Flores-Banda Basin (Silver et al. 1983), which is a geologically young marginal continental back-arc sea, is part of this complex system.

The volcanically active island-arc is cut and displaced by various large, obliquely striking fault systems. Because of this particular geological setting (arc-fault intersections), the southeastern and eastern segments of the arc form a belt of magma production coupled with fault-associated permeabilities, leading to ideal geologic conditions for the development of hydrothermal convection cells and potential mineral precipitation. Thus, a detailed tectonic analysis is vital for the detection of such hydrothermal systems. In the path of the circulating fluids, rocks are increasingly altered, metals and alkalis are leached, and heat is transported to the seafloor (together with the chemical load). Depending on the rock/sediment types through which the hot fluids pass, the composition of the resulting mineral precipitates on the seafloor varies.

After a high-resolution bathymetric mapping in the northern transitional arc region between Flores and Wetar (~36 km north of the island of Lomblen) and a successive analysis of lineaments on the seafloor, a target area was defined which suited our research aims. There, we collected sulphide-impregnated volcanic rocks from a previously unknown seamount and found temperature anomalies in the water column adjacent to the mineralised site (Halbach et al., 2002). This supports our view of ongoing submarine hydrothermalism in the area. Subaerial fumarolic activity and a small geothermally fed stream were observed on the southern slope of Komba volcano (Batu Tara).

Methods and Station Work

About 240 km² of seafloor were mapped during a high-resolution hydrographic survey using the Multibeam Echosounder System SEABEAM 1050 (ELAC). A Parasound Echograph System (Atlas) was employed to identify fault positions on the seafloor, which are possible sites for hydrothermal discharge. The search for hydrothermal activity was supplemented by vertical CTD profiling of the water column. Hard rocks were sampled by box-dredge and Van Veen grab.

Bathymetry and Interpretation of Local Tectonics

The bathymetric survey of some 240 km² north of the island of Lomblen resulted in a very detailed map and the discovery of two submarine summits southeast of the subaerial Komba volcano (Fig. 2). The northwestern part of the area comprises the "Abangkomba" seamount with a minimum water depth of 112 m, while the "Ibukomba" seamount in the southeast has a minimum water depth of some 900 m (both summits were tentatively named by the Indonesian colleagues during the cruise). According to their steep slopes and morphologies, these structures are considered to constitute relatively young volcanoes.

The NW-SE alignment of Komba Island (Batu Tara), Abankomba, and Ibukomba (elongation ~50 km) suggests the presence of a previously unknown neo-volcanic ridge-like tectonic element. We called this structure the "Komba-ridge". Based on morphological features, we assume that this "ridge" becomes younger towards the northwest. It is fractured and dominated by normal faults, which strike NW-SE (Fig. 2) and indicate NE-SW extension. Normal faults exist on both sides of the ridge and they are more or less parallel to the general strike. Two faults are larger and longer; they tectonically bound the Abangkomba and the Ibukomba volcanoes. These normal faults are cut by a pronounced displacement, which is interpreted as a local left-lateral transcurrent fault with more or less E-W strike. We suggest that this fault was created by E-W back-arc basin elongation that dissected the volcanic ridge in an E-W direction. The resulting zigzag-shaped, 2- to 3.5-km-wide plain (water depth ~1200 m) separates the summits of Abangkomba and Ibukomba. The plain is morphologically homogeneous and resembles a sediment-filled pull-apart basin (Fig. 2). The intersections of the normal faults with the younger transcurrent displacement faults are significant target areas for finding hydrothermal mineralisations.

In an interpretation of the present

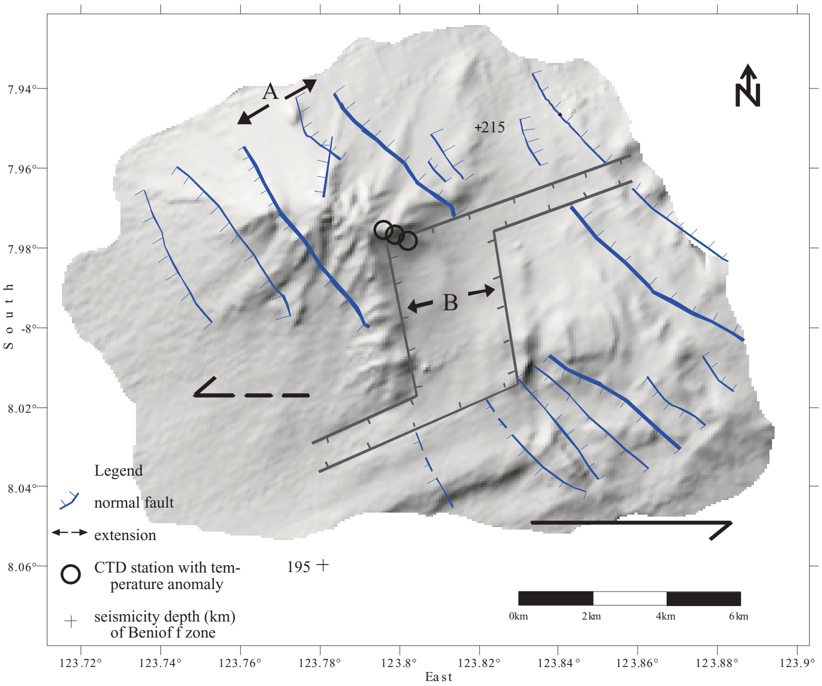

Figure 2. Greyscale shaded-relief map showing seamounts, proposed strike-slip basin, CTD sampling sites, and structural interpretation.

International Research: Back Arc Basins: Halbach et al., cont...

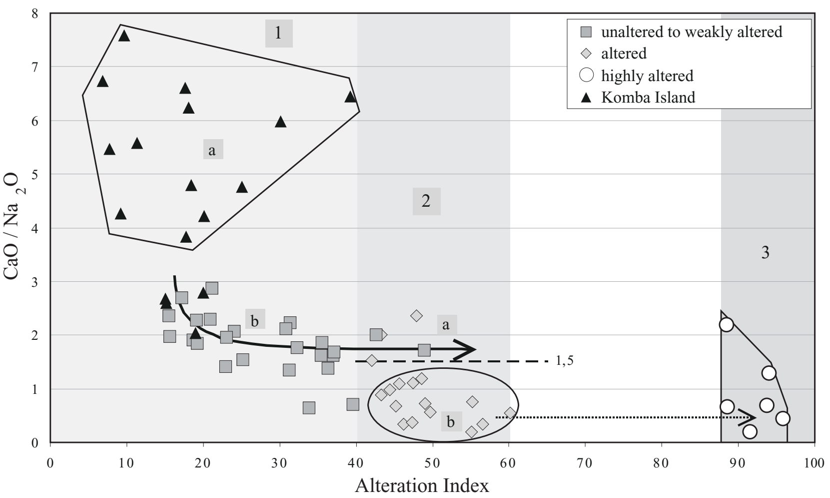

Figure 3. Ca and Na compared to alteration index for various samples collected.

deformational system in the eastern Sunda-Banda arc, McCaffrey (1988) considers several independent crustal blocks (microplates). It is, however, not clear whether the region actually consists of separate rigid blocks or if it is characterised by plastic deformation. McCaffrey (1988) infers that strike-slip motion plays a very important role in the deformation of the arc during collision. The Savu Basin Block (SBB), therefore, is regarded as a separate block moving SSW with respect to the Australian plate. The northern boundary of the SBB is inferred to be an east-trending, right lateral transform fault immediately north of the volcanic arc.

According to the decreasing age toward the northwest to the Komba volcano, the ridge might constitute a propagating extensional system that breaks up the Flores Sea crust. This model also fits with the interpretations of McCaffrey (1988), who defined a right-lateral strike-slip at the northern boundary of the Savu Basin block and also a NNE convergence between the Indian Ocean plate and the volcanic arc. This tectonic configuration results in a divergent situation with extensional deformation beginning at a point at the northern end of the Alor-Pantar Strait. It also represents the intersection of the projected strike of the Komba-ridge with the western most left-lateral strike-slip fault (Semu fault), which divides the Savu block from the Alor block. Applying the relative strike-slip rates from McCaffrey (3.2 ± 1.6 mm/a for the northward motion of the Alor block versus the Savu block and 1.2 ± 0.6 mm/a for the E-W elongation), we derive motion to the NNE which, together with the southward direction of the Savu block, might cause extension at the Komba-ridge that increasingly breaks apart the Flores Sea crust.

Petrography and Geochemical Composition of the Volcanic Rocks

All sampled volcanic rocks (lavas and pyroclastics) are K-rich (2.5 to 6.6 wt.% K_2O) and range in bulk-rock composition between basaltic trachyandesites and trachydacites. Many of the rocks have undergone illitisation, propylitisation, and saussuritisation, with the respective formation of illite, calcite, quartz, epidote, and chlorite. The stronger this alteration the higher is the sulphide content of the samples (up to 6 wt.%), which is also accompanied by increasing silicification. Pyrite dominates the sulphide assemblage and forms irregular impregnations or fracture fillings, while pyrrhotite and chalcopyrite are of minor importance.

The main volcanic rock covering the Ibukomba site is pumice, whereas the Abangkomba in the north contains pumice in association with a suite of mafic to intermediate volcanic rocks and alterites; samples from the subaerial Komba volcano are exclusively mafic alkalic rocks.

The rock samples from the Abangkomba and Ibukomba seamounts are characterized by SiO_2 contents ranging between 53.5 and 68 wt.%, while MgO varies between 0.19 and 4.20 wt.%. K_2O and Na_2O range from 2.20 to 6.63 and 0.18 to 4.44 wt.%, respectively and, thus, all samples belong to the high-K volcanic series. Corresponding to increasing SiO_2 and alkali contents, most of the samples plot in the fields basaltic trachyandesite, trachyandesite, and trachydacite.

In order to discern elemental changes that could be attributed to alteration processes as well as trends in magma evolution, we developed the following alteration index (AI; Eq.1):

$$AI = 100 * (0.1Al_2O_3 + 2LOI) / (0.1Al_2O_3 + 2LOI + MgO + CaO + Na_2O) \quad \text{(Eq.1)}$$

This calculation produces a fine data resolution with values ranging between 15 (low AI) to 96 (high AI); the latter samples also show the strongest alteration phenomena in thin sections. The volcanic rocks plot in three major groups (Fig. 3): 1) AI ≤ 40: unaltered to weakly altered rocks; all Komba Island samples belong to this group, 2) AI = 40 to 60: altered rocks (transitional group), 3) AI ≥ 88 highly altered rocks.

The Komba Island samples and the Abangkomba/Ibukomba volcanics derive from the same geotectonic structure and are, thus, genetically related. Both suites are characterized by high K_2O concentrations; regionally, they are closely associated with calcalkaline arc volcanics less rich in K_2O and located in the south. First metal analyses of these rocks show a low concentration in noble metals: Gold in sulphide-impregnated and highly altered samples (several percent of sulphide minerals) only reaches 150 ppb (0.15 g/t), while silver concentrations are ~4 ppm (4 g/t). This is not surprising, since our samples are thought to originate from the altered surroundings of an epithermal deposit. Arsenic levels in the "gold-rich" pyritic samples rise to 80 ppm, demonstrating the association of Au and As. Other metal concentrations in the same samples reach a maximum of 106 ppm Zn, 100 ppm Cu, and 80 ppm Pb.

Discussion and Conclusions

The BANDAMIN target area is located close to an active volcanic arc in an area where an older propagating extensional fault system breaks up the eastern Flores-Basin crust and results in the extrusion of alkalic volcanics. The NW-SE striking normal faults linked to this extension were identified by our hydroacoustic survey. A younger tectonic structure has since cut and displaced the normal faults in the area between the Abangkomba and the Ibukomba seamounts. The resulting zigzag-shaped structure (pull-apart basin?) is related to left-lateral transcurrent displacement. The faults, which outline the approximately N-S striking boundaries of the resulting pull-apart basin, cut the older extensional faults; a smaller N-S striking fault was also observed in the NE part of our study area. The intersections between these younger N-S striking faults with the older extensional faults are prospective localities for hydrothermal fluid emanations and for hydrothermal mineralisations. The CTD-stations, which showed weak temperature anomalies, are at the northwestern boundary of the pull-apart structure. This suggests that at least some relict heat flux and fluid flow still exist. Based on these results, we selected future study sites at fault intersections in the Abangkomba area; these sites should be examined in a follow-up cruise, possibly in summer 2003.

The high K-contents of the volcanic rocks from our research area most likely reflect the heterogeneous evolution and magma mixing in the mantle below the Komba ridge. Van Bergen et al. (1992) suggest that the Komba Island volcanics are hybrids, since they carry minerals from different parental magmas. They concluded that these magmas obtained their characteristics at depth, i.e., the melt mixing occurred within the mantle wedge prior to the rising of the magma. This model implies a dynamic mixing of three source components resulting in two melt fractions. One is the typical arc melt derived from the depleted MORB source and strongly influenced by subducted crustal materials (e.g., sediments). The second melt originates from an OIB type mantle. However, it is unclear in which physical form this OIB material exists (veins, plumes or diapirs from the deeper mantle). The OIB component becomes more pronounced away from the trough. On the other hand, the calcalkaline influence increases closer to the trench.

Land-based epithermal mineral deposits in which gold and silver are the dominant economic metals are widespread in convergent tectonic settings associated with volcanic arcs. Basically, there are two epithermal mineralisation styles: low-sulphidation and high-sulphidation (White and Hedenquist, 1995). Despite similarities in alteration mineralogy, the distribution of alteration zones and the shape of ore bodies are different. Thus, both knowledge of the tectonic setting and the identification of alteration types can point towards the most likely area of hydrothermal outflow for such a system. Generally, the mineralisation is structurally controlled and concentrates at fault intersections in the form of larger veins with sharp boundaries to the host rocks, or as stockworks with mineralized veinlets. It is important to locate former vent outlets, because high-grade ore accumulations generally occur in the conduit vein zones.

Since most epithermal mineralisations form at temperatures between 180 and 280°C, the identification of temperature-sensitive mineral phases is essential for the determination of the mineralisation type. Clay minerals, for instance, which dominate the alteration mineralogy of low-sulphidation environments, reflect the formation temperature in their composition and lattice constants. A good example is smectite, which is stable above 160°C. However, with increasing temperature, the content of this mineral diminishes in favour of mixed-layer illite-smectites, while illite becomes stable above 220°C. Temperature-sensitive minerals also include Ca-silicates, such as epidote, which is stable above 200 to 240°C.

This T/pH-dependent variation in mineral stabilities results in an upward and outward oriented mineralogical zonation around low-sulphidation ore bodies. The zones form haloes that are centered on the vein system and the high-grade ore body. Propylitic alteration, for example, occurs in regions of low water-rock ratios, and is more distal to the conduit zones. The typical mineralogy associated with propylitic alteration includes albite, calcite, chlorite, epidote, and pyrite. Illite with secondary amorphous SiO_2 and/or quartz, some adularia and pyrite, on the other hand, indicate higher temperatures and are more proximal to the ore veins.

The presence of albite, K-feldspar, and calcite in some of the altered volcanic rocks from the Abangkomba area and the respective lack of kaolinite, alunite, and pyrophyllite suggests a more distal epithermal low-sulphidation system rather than a high-sulphidation deposit. The fluids that equilibrated with the host rocks must have been more reducing and almost neutral in pH (Giggenbach, 1992), because minerals that are typical for this geochemical regime, such as calcite, are common components in our samples.

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The conditions required for such an environment (propylitic) are produced by boiling fluids in the hydrothermal conduits, because the loss of CO_2, H_2S, and H_2O causes an increase of the pH in the residual fluid as well as a decreasing temperature.

The second type of alteration essentially consists of illite and SiO_2 phases (amorphous silica and quartz), some minor amounts of adularia, and pyrite impregnations. This mineralogy indicates a total breakdown of plagioclase and higher alteration temperatures. Thus, these alterites derive from sites more proximal to the epithermal ore-bearing veins. The fact that even more intensely mineralized ore samples existed in the Abangkomba area is documented by the gossan samples from the southern slope of the Komba-ridge. These rocks represent completely oxidized sulphides and are highly ferruginous (30% Fe_2O_3). Since the samples were dredged from the surface of the Abangkomba, we expect less oxidized sulphidic mineralisations to exist in close vicinity to the place from which the gossan samples were taken.

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Shallow drilling of seafloor hydrothermal systems using R/V Sonne and the BGS Rockdrill: Conical Seamount (New Ireland Fore-Arc) and Pacmanus (Eastern Manus Basin), Papua New Guinea

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Abstract

In September-October 2002, shallow seafloor drilling using the portable 5 m Rockdrill of the British Geological Survey and the German R/V Sonne revealed critical information on the sub-surface nature of two distinct hydrothermal systems in the New Ireland fore-arc and the Manus Basin of Papua New Guinea. Drilling of 39 holes at the summit plateau of Conical Seamount close to Lihir Island has indicated that previously discovered epithermal-style gold mineralisation reaches to a depth of at least 4.5 m below seafloor with gold concentrations of up to 14.2 g/t Au. This discovery significantly extends the known surface extent of gold mineralisation (up to 230 g/t Au) at Conical Seamount. Almost 9 m of spectacularly textured massive sulphide core recovered from 10 holes drilled in only two days in the active Roman Ruins black smoker site of the Pacmanus area proves, that massive sulphides extend to a depth of at least 5 m below seafloor. Spectacular concentrations of gold were found in several core sections including 0.5 m @ 28 g/t Au, 0.35 m @ 30 g/t Au, and 0.20 m @ 57 g/t Au, confirming the gold-rich nature of this particular back-arc deposit. Shallow seafloor drilling is a fast and cost efficient method that bridges the gap between surface sampling and deep (ODP) drilling and undoubtedly will become a standard

practice in the future study of seafloor hydrothermal systems and massive sulphide deposits.

Introduction

Our current knowledge of seafloor hydrothermal systems and massive sulphide deposits is largely based on surface sampling by dredges, TV-guided grabs, submersibles and ROVs, and deep drilling by the Ocean Drilling Program (ODP). In the past decade, ODP has drilled a total of three different hydrothermal sites including Middle Valley at the Juan de Fuca Ridge (Zierenberg et al., 1998), the active TAG hydrothermal mound at the Mid-Atlantic Ridge (Herzig et al., 1998a, Humphris et al., 1995), and the Pacmanus area in the eastern Manus Basin (Binns et al., 2002). Due to the need to set casing for deep hard rock drilling, coring of the immediate subsurface is usually not possible during ODP operations, thus leaving a significant gap between surface sampling and deep drilling. We have, for the first time, deployed the British Geological Survey (BGS) Rockdrill from the German R/V Sonne and successfully demonstrated that shallow seafloor drilling with a lander-type system is feasible from a non-drilling research vessel and significantly extends our understanding of the 3rd dimension of seafloor hydrothermal systems and massive sulphide deposits. Here, we present first results of a recent drilling and coring program at Conical Seamount (New Ireland fore-arc) and Pacmanus/Roman Ruins (Eastern Manus Basin).

Geological Setting of Drill Sites

Conical Seamount (Fig. 1) is one of several young volcanic cones discovered in the area south of Lihir Island in the New Ireland fore-arc in 1994 (Herzig et al., 1994). It has a basal diameter of 2.5 km and rises about 600 m above the surrounding seafloor (1.650 km water depth) with a well-developed summit plateau (150 x 200 m) at 1.050 km water depth. First indications of gold-rich epithermal-style vein mineralisation at the summit plateau of Conical Seamount were discovered in 1994 (Herzig et al., 1995) and confirmed 1998 (Herzig et al., 1998b, 1999). Samples collected from the summit area include locally intense clay-silica alteration immediately adjacent to an eruptive fissure. Gold-rich polymetallic vein mineralisation occurs in an outer zone of this area while arsenic sulphides together with abundant amorphous silica are found at the margins. More than 1 200 kg of mineralized rock were recovered in 1998, consisting of stockworks and disseminated sulphides with gold concentrations locally reaching up to 230 g/t (avg. 26 g/t, n=40, Herzig et al., 1999, Petersen et al., 2002). The material recovered from Conical Seamount is similar to the ore currently being mined from the giant Ladolam epithermal gold deposit in the crater of Luise Volcano on Lihir Island, and both sites may be linked by the same magmatic system. For the marine environment, Conical Seamount represents a new type of mineralisation that is different from black smoker-type deposits and has been formed through contributions of magmatic fluids and metals (Petersen et al., 2002). This has important implications for the understanding of epithermal-style ore mineralisation in submarine arcs as well as on the continents.

The Pacmanus hydrothermal field (Fig. 1) in the Eastern Manus back-arc basin is situated on the crest of Pual Ridge, an elongated feature composed of dacite with subordinate basaltic andesite and rhyodacite that stands 500-700 m above the surrounding basin floor (Binns et al., 2002). Five principal areas of hydrothermal activity have been delineated at Pacmanus including Roman Ruins, which consists of

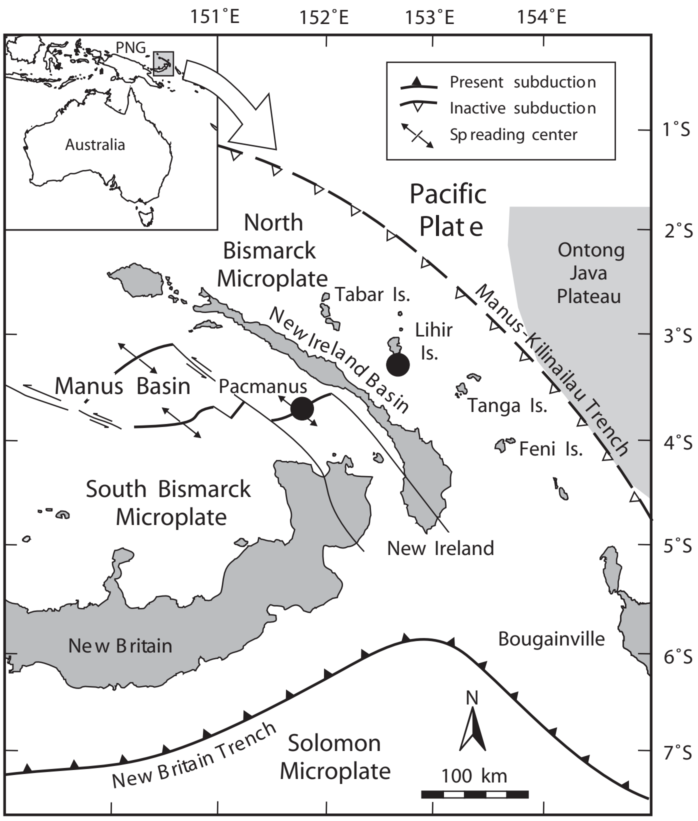

Figure 1. (Rock) drill sites (solid circles) at Conical Seamount (south of Lihir Island) and Pacmanus/Roman Ruins (Eastern Manus Basin). Cruise SO-166 of R/V Sonne.

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active and inactive black smoker chimneys with exit temperatures of up to 276°C (Binns et al., 2002). The Pacmanus area was subject to ODP drilling during Leg 193; however, the massive sulphides were not cored due to casing requirements for deep drilling (Binns et al., 2002).

Results

Out of 41 attempts, 39 holes were drilled in various areas of the summit plateau of Conical Seamount with only two core barrels returning without recovery (Table 1). The total penetration achieved was more than 91 m with individual penetration varying between 0.95 and 5.0 m (avg. 2.3 m). With an average recovery of 31%, almost 21 m of core were drilled with individual core length of up to 1.5 m (avg. 0.51 m).

Drilling at Conical Seamount has confirmed the sub-seafloor extent of surface gold mineralisation and associated epithermal-style alteration to a depth of at least 4.5 m below the seafloor and further supports analogies to the giant Ladolam epithermal gold deposit on Lihir Island. Drill-core samples of clay-silica alteration contain gold grades up to 14.2 g/t Au (30 g fire assay: Lihir Gold Ltd.) and appear to be part of a more extensive gold zone located below a carapace of relatively fresh ankaramite and trachybasalt. These samples contain a complex mineralogy including realgar, orpiment, galena, sphalerite, some chalcopyrite and pyrite, together with amorphous silica, and possibly cinnabar. In addition to high concentrations of gold, shipboard XRF analyses indicate that the gold-rich samples contain high values of Pb (up to 2.6 wt.%), As (up to 9250 ppm), and Sb (up to 954 ppm), and low contents of Cu (up to 0.3 wt.%) and Zn (up to 5.2 wt.%) which is a characteristic feature of a magmatic-hydrothermal style of mineralisation.

Drilling of 10 holes in only two days at Roman Ruins (Pacmanus site) achieved a total penetration of almost 36 m. The average penetration was 3.6 m (2.1-5.0 m) with a recovery of about 31% (9-65%), resulting in about 11 m of core of which almost 9 m are spectacularly textured massive sulphides. The longest sulphide cores taken measure 2.2 m (penetration 4.9 m), 1.9 m (penetration 5.0 m), and 1.4 m (penetration 2.8 m).

The sulphide-bearing cores are usually dominated by light brown to dark brown sphalerite with varying proportions of barite, pyrite and chalcopyrite. Galena and bluish sulphosalts are visible, but occur only as a minor to trace component in the sulphides. Anhydrite, amorphous silica and variably altered dacite fragments occur together with the sulphides. The textures, in most cases, resemble those of sulphides recovered from the surface of the Pacmanus field (Moss and Scott, 2001). Ribbon banded sphalerite, as observed in "beehive" smokers at various other seafloor hydrothermal sites, is common, as are relics of individual chalcopyrite-lined chimney orifices.

Drill site 60RD recovered a sphalerite±chalcopyrite and barite assemblage underlain by a nodular breccia of rounded chalcopyrite+pyrite clasts set in a matrix of anhydrite. This nodular texture

Table 1. Drilling statistics for sites Conical Seamount (New Ireland fore-arc) and Pacmanus/Roman Ruins (Eastern Manus Basin)

Parameter	Conical Smt	Roman Ruins
Number of holes	41	10
Technical failures	2	0
Holes without recovery	2	0
Total penetration	91.07 m	35.55 m
Individual penetration	0.95-5.00 m	2.06-5.00 m
Average penetration	2.34 m	3.56 m
Total core length	20.76 m	11.07 m*
Individual core length	0-1.50 m	0.35-2.20 m
Average core length	0.51 m	1.12 m
Average recovery	31%**	31%
Individual recovery	0-100%	9-65%

*8.87 m of massive sulphide

**based on 37 holes drilled with recovery

Figure 2. BGS Rockdrill during drilling operations with R/V Sonne in the New Ireland fore-arc and the Manus back-arc.

Figure 3. Handling of core during Cruise SO-166 at Conical Seamount.

strongly resembles cores from the central part of the TAG hydrothermal field (Humphris et al., 1995; Herzig et al., 1998a). The presence of abundant anhydrite within this core is indicative of seawater penetrating into the massive sulphide mound and mixing with the hydrothermal fluid and/or conductively cooling in the subsurface. The nodular appearance of the chalcopyrite+pyrite fragments suggests that massive sulphides are reworked likely due to the formation and dissolution of anhydrite. This observation is supported by several cores that contain layers of fine-grained, clastic chalcopyrite+pyrite sand.

A 20 cm thick layer of massive, dense chalcopyrite separating layers of porous, massive sphalerite has been sampled in the upper part of one hole, while other holes contain a similar section where chalcopyrite is intergrown with black sphalerite. The complex intergrowths observed throughout the core sections imply a multi-staged hydrothermal evolution of the deposit.

Four of the holes drilled at Roman Ruins penetrated close to 5 m into the massive sulphide mound. Out of these, two holes (61RD and 69RD) ended in weakly to intensely altered dacite possibly indicating that sulphide formation here is limited to a thin veneer above the underlying altered dacite. Core 69RD recovered 1.8 m (core length 2.2 m) of massive sulphide overlying strongly clay-silica altered and sulphide veined dacite that mark the onset of the stockwork zone.

Preliminary analyses of quarter core sections (varying in length from 10 to 50 cm) indicate high base and precious metal contents averaging close to 12 g/t Au, 170 g/t Ag, 21 wt.% Zn, 5 wt.% Cu, and 1 wt.% Pb. The most impressive grades come from hole 65RD which returned 0.4 m @ 35 g/t Au, 240 g/t Ag, 7.1 wt.% Cu, 26.9 wt.% Zn, and 0.6 wt.% Pb, including a section of 0.2 m with 57.2 g/t Au. Another exceptional result came from hole 66RD which returned 0.8 m @ 19.5 g/t Au, 190 g/t Ag, 7.7 wt.% Cu, 25.2 wt.% Zn, and 0.2 wt.% Pb. The longest core (69RD, penetration: 4.9 m) recovered 2.2 m @ 11.3 g/t Au, 160 g/t Ag, 2.4 wt.% Cu, 26.0 wt.% Zn, and 0.9 wt.% Pb.

Gold enrichment throughout the cores is related to sphalerite-rich sections. The highest grades occur in dark brown to black sphalerite that is associated with abundant chalcopyrite and was presumably deposited at higher temperatures. However, core sections that contain ribbon-banded, light brown sphalerite are also enriched in gold. Low precious metal concentrations, despite high concentrations of Zn and Cu, have been observed in the lower parts of some cores, possibly indicating that zone refining is responsible for some of the precious metal enrichment observed at Pacmanus. This is consistent with the low gold contents in the reworked nodular chalcopyrite+pyrite+anhydrite breccias.

TV-guided grab sampling that accompanied the drilling program recovered massive sulphides as well as active and inactive chimneys from the Satanic Mills and Roman Ruins sites. Some samples from the mound surface at Roman Ruins show a knife-edge contact between least altered, black dacitic hyaloclastite set in a matrix of porous sphalerite and intensely clay-altered white dacite fragments cemented by chalcopyrite, pyrite and sphalerite. This suggests the presence of an alteration or high temperature front just below the seafloor. A strongly siliceous, black to dark brown layer occurs in several samples suggesting the presence of a siliceous cap in certain areas.

Conclusions

The successful drilling and coring operations with the BGS Rockdrill and R/V Sonne indicate that shallow seafloor drilling is filling the sampling gap between the seafloor and the deeper parts of hydrothermal systems. Drilling at Conical Seamount and Roman Ruins has provided information not previously available and attests to significant sub-surface mineralisation in both areas. Results obtained by drilling at the summit plateau of Conical Seamount now conclusively indicate that deeper drilling is required (and justified) to fully assess the gold resource of this deposit. At Roman Ruins, drilling with the BGS Rockdrill has not only proven the existence of massive sulphides in the sub-seafloor but also demonstrated their gold-rich nature. Shal-

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Figure 4. Drill core recovered with the BGS Rockdrill from the Pacmanus hydrothermal field.

low seafloor drilling will likely become a future standard practice in the evaluation of seafloor hydrothermal systems and portable drill rigs such as the Rockdrill may even advance to mission specific platform status within the new phase of ocean drilling (IODP).

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Preliminary report of Kairei KR03-01 cruise: amagmatic tectonics and lithospheric composition of the Parece Vela Basin

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Introduction

Recent mapping studies by our group (Kasuga and Ohara, 1997; Okino et al., 1998; 1999; Ohara et al., 2001) revealed that the Parece Vela Basin (PVB) in the Philippine Sea (Fig. 1) has the geodynamic characteristics expected for amagmatic extension, thus providing a rare opportunity to study the architecture and composition of backarc basins. The study of backarc spreading systems has a strong bearing on two important aspects of the Earth's evolution, as it relates to both subduction zone and mid-ocean ridge dynamics. Study of backarc basins thus has strong impact on both the InterRidge and MARGINS communities.

The KR03-01 cruise aboard the Japan Marine Science and Technology Center's R/V Kairei was thus scheduled to better understand the lithospheric architecture and composition of this unique backarc basin (Ohara et al., 2002). In this article, we report the preliminary results of the cruise.

Geodynamic background

The Philippine Sea occupies a large part of the western Pacific and is composed of three large basins separated by the Kyushu-Palau and West Mariana ridges (both are remnant arcs; Fig. 1). Situated east of the Kyushu-Palau Ridge, the Shikoku Basin and the PVB are extinct backarc basins. The central PVB is characterized by a N-S trending chain of right-stepping en-echelon depressions (the Parece Vela Rift; Mrozowski and Hayes, 1979) bordered by escarpments extending ~N20°E from the depressions into the surrounding basin floor (Fig. 2). The escarpments and depressions (maximum depth ~7500 m) are fossil fracture zones and extinct segmented-spreading axes (first-order segments), respectively (Kasuga and Ohara, 1997). Each segment is labeled as S1-S7 from south to north (Ohara et al., 2001). The PVB has a two-stage spreading history (Kasuga and Ohara, 1997; Okino et al., 1998; 1999), initial E-W rifting and spreading with spreading axes trending N-S began at ~29 Ma (spreading rate: 8.8 cm/y full-rate) (Okino et al., 1998; 1999). The second stage involved counter-clockwise rotation of spreading axes from N-S to NW-SE at ~19 Ma (spreading rate: 7.0 cm/y full-rate) (Ohara et al., submitted).

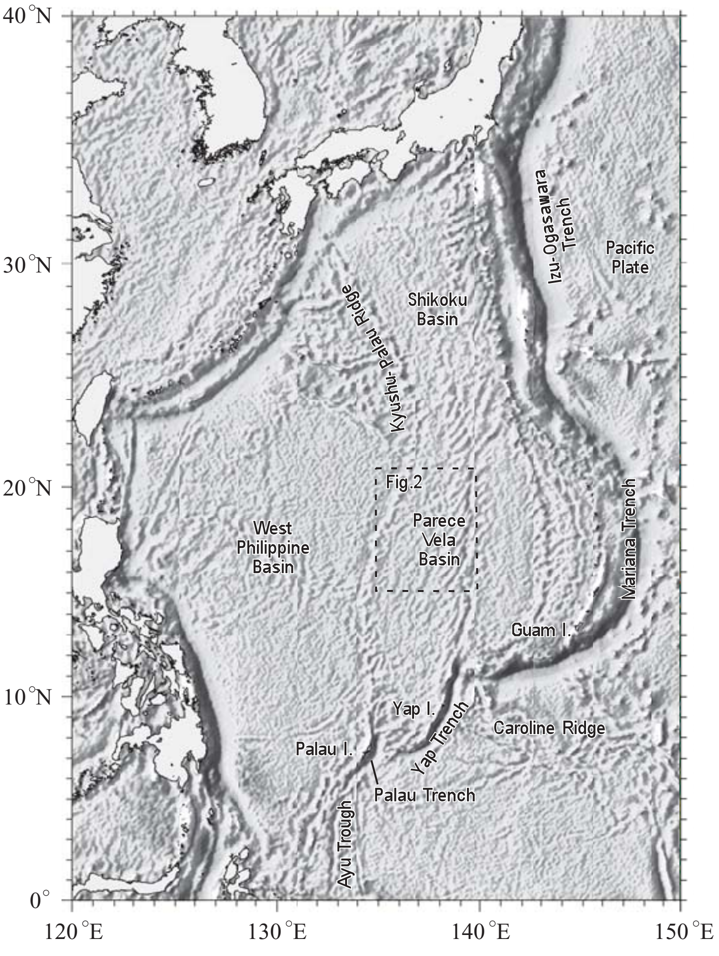

Figure 1. Satellite altimetry map showing the tectonic feature of the Philippine Sea. Dotted box indicates the location of Fig. 2.

International Research: Back Arc Basins: Ohara et al., cont...

Spreading ceased at ~12 Ma (Ohara et al., submitted).

Ohara et al. (2001) mapped distinct rough topographic features in the PVB, suggesting amagmatic extension in the basin, in spite of the basin's relatively fast-spreading rate (8.8-7.0 cm/y full-rate). The most distinct topographic feature is a set of megamullions in the Parece Vela Rift (PVR). Recently discovered "megamullions" found along slow-spreading ridges have been interpreted as exhumed footwalls of low-angle normal faults, characterized by distinct corrugations normal to the spreading axis (Cann et al., 1997; Blackman et al., 1998; Mitchell et al., 1998; Tucholke et al., 1998). One of the PVR megamullions is the largest seafloor megamullion known. Ohara et al. (2001) named it the Giant Megamullion, as it is ~10 times larger in area than the Mid-Atlantic Ridge (MAR) megamullions. The other distinct topographic feature is a rugged "chaotic terrain" in the off-axis region of the western PVB. This terrain consists of isolated and elevated blocks (maximum relief is ~1500 m), capped by corrugated axis-normal lineations, and associated deeps (maximum depth ~6000 m). The chaotic terrain has a mantle Bouguer anomaly distinctly higher than the surrounding ocean basin, about 30 mgal, indicating a thinner crust beneath the area (Okino et al., 1998). The morphology and gravity signature of these individual blocks are also similar to MAR megamullions. Similar off-axis rugged topography has been documented at the "high" intermediate-spreading Australian-Antarctic Discordance (7.4 cm/y full-rate) and reflects a long-term magma deficiency associated with a mantle cold spot (Christie et al., 1998).

Before the KR03-01 cruise, mantle peridotites were sampled in only two previous dredge hauls in the PVR; no bottom samples were obtained from the chaotic terrain. However, the limited sample suites revealed fundamental characteristics of the backarc basin lithospheric composition (Ohara et al., in press). The most notable characteristic of PVR peridotites is the existence of fertile peridotite (spinel Cr# (= Cr/Cr+Al ratio) ~0.17), accompanied by melt-impregnated peridotite with more depleted composition. The existence of fertile peridotite indicates that PVR peridotite experienced only minor melting (4% near-fractional melting of a MORB-type mantle), most likely due to inhibited mantle melting caused by closely-spaced fracture zones (Ohara et al., submitted). The extreme water depth of the PVR (maximum depth ~7500 m) also supports cold magma. The estimated low degree of melting of the PVB upper mantle is, to a first approximation, consistent with bathymetric features suggesting amagmatic extension.

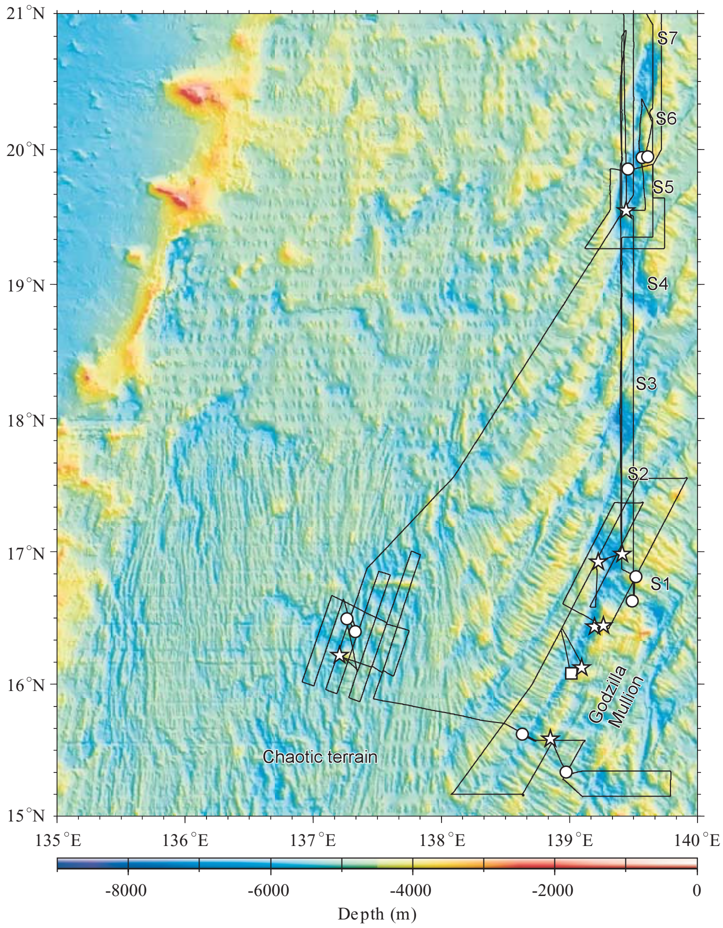

Figure 2. Shaded bathymetry of the Parece Vela Basin showing the cruise tracks of R/V Kairei during the KR03-01 cruise. Bathymetric data are from this cruise as well as previous cruises (Ohara et al., 2001). The short, first-order segments are labeled S1-S7 from south to north. Asterisks indicate dredge hauls containing peridotites, circles indicate dredge hauls containing mostly basalts. A square indicates an empty dredge haul. Our mapping confirmed the presence of several megamullions in the chaotic terrain, yielding mantle peridotite from a single dredge haul. The Godzilla Mullion yields peridotites from the entire length of over 125 km (4 dredges). Some dredge hauls from the Godzilla Mullion contain plagio-granite. A voluminous axial blocky ridge in the rift valley of S6 yields peridotites, indicating this structure is possibly a remnant inside-corner high massif. "Crab-leg ridges" are clearly seen in the southern off-axis of S6.

Preliminary results

The Kairei left Yokosuka on January 6, 2003 and returned to Yokosu-

International Research: Back Arc Basins: Ohara et al., cont...

ka on January 25, 2003. The expedition to the southern Philippine Sea was incredibly successful, resulting in 18 dredge hauls and extensive geophysical mapping (bathymetry and magnetic surveys; gravity data were not recorded) during the 20-days cruise, mainly focused on the chaotic terrain and the ridge-transform intersections (RTI) of segments S1, S2, S6 and S7. Some of the remarkable results can be summarised as follows (Fig.2):

1) Extensive swath mapping oblique to the chaotic terrain confirmed that it is actually composed of several individual megamullions. Dredging on one of the several megamullions recovered mantle peridotites and gabbros, documenting an extremely thin crust with extensive tectonic dismemberment.
2) Four dredge hauls on the Giant Megamullion revealed it to be composed nearly entirely of mantle peridotite along its entire length of over 125 km. This suggests a peridotite exposure of some ~7000 km^2, confirming this structure is the largest exposure of amagmatic or nearly amagmatic ocean crust in the world. We thus renamed it "Godzilla Mullion", since it deserves to have the name of the world-famous Japanese monster.
3) Although oceanic plagio-granite has been very rarely reported (e.g., Engel and Fisher, 1975), we recovered plagio-granites associated with mantle peridotites from the Godzilla Mullion surface, suggesting small volumes of melt were highly fractionated in this magma-starved spreading environment.
4) We mapped the northern segments (S6 and S7), which were previously poorly mapped. The rift valley of S6 and S7 are both oblique to the fracture zones, indicating oblique extension was dominant during the final phase of the basin evolution. A minor elongated ridge and a voluminous blocky ridge (~1600m relief) are located in the rift valley of S6. Dredging the former recovered a large volume of basalt, whereas the latter yielded a large volume of peridotite. We interpret the former is a "normal" neovolcanic ridge in S6, whereas the latter may be a remnant inside-corner high massif.
5) The southern off-axis region of S6 is characterised by prominent curved abyssal hills that look like "crab legs". We interpret these as extreme expressions of "hooked ridge", well described along mid-ocean ridge RTI. Compared to normal hooked ridges, the PVR crab-leg ridges are anomalous due to their abrupt changes in orientation along axis and in the length of the "hooks".

We interpret that these observations reveal a dramatic magmatic undersupply more typical of an ultraslow-spreading ridge than of a fast- or intermediate-spreading ridge in a backarc basin. The results imply that the morphologic and petrologic characteristics of ridges we normally assume to be a direct function of spreading rate are in fact solely a function of magmatic supply.

Acknowledgements

We are grateful to captain Osamu Yukawa and crews of R/V Kairei for their professional work during the cruise. KR03-01 Shipboard Scientific Party includes Teruaki Ishii, Osamu Ishizuka, Hiroshi Sato, Hiroyuki Yamashita, Yi Bing Li, Matthias Willbold, Yohei Shimizu, Maik Biegler, Yutaka Matsu'ura, and Yusuke Sato.

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International Research: Ophiolites

The heterogeneity of ophiolite association in the Kronotsky paleoarc basement (Eastern Kamchatka)

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Introduction

Ophiolite complexes of different age and genesis are widely spread in the accretion-collision around the Pacific Ocean, and the nature of many of them remains obscure. As a rule they are subdivided tectonically and often they correlate spatially with island arc terrains, which form the accretion-collision structure of this region.

The authors carried out a study of ophiolites on the Eastern Kamchatka peninsulas (Fig.1), which represent fragments of a Late Cretaceous-Eocene island arc. This was included in the accretion structure of the northwestern Pacific in Cenozoic time (Zinkevich and Tsukanov, 1993, Levashova, et al., 2000). The correlation of different ophiolite fragments and, correspondingly, conditions of their formation are still under discussion.

The rare earth elements (REE) and other trace element contents in mafic and ultramafic rocks were determined by ICP-OES, ICP-MS, and XRF methods following chromatographic separation and concentration. The composition of rock-forming minerals of these rocks was analyzed using a Cameca SX 100 microprobe. The analytical work was conducted at the GeoForschungsZentrum Potsdam, Germany.

Geological background

The Kamchatka Mys and Kronotsky peninsulas have complicat-

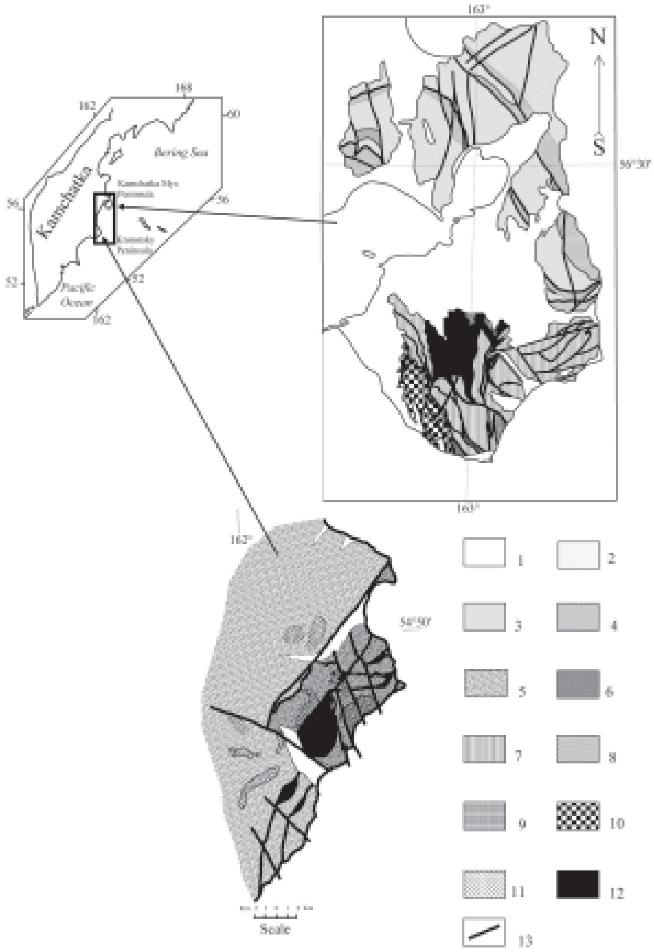

Figure 1. Geological sketch of the Kamchatka Mys and Kronotsky peninsula. Key: 1. Pliocene-Quaternary sediments; 2. Tushevka formation; 3. & 4. Stolbovskaya formation: 3. Baklanovskaya, Rifovskaya and Verecshaginskaya subformation; 4. Tarhovskaya subformation; 5. Kronotskaya formation; 6. Kamensky complex; 7. Pikezhsky complex; 8. Kamenistskaya subformation; 9. Afrika Group; 10. Olenegorsk Gabbro Massif; 11. Gabbro; 12. serpentinized peridotites and serpentinite mélanges; 13. thrust faults.

ed fold and nappe structures and are made up of Cretaceous and Paleocene-Eocene volcanic and tuffaceous terrigenous rocks and thrust sheets and flakes composed of serpentinite mélange, gabbros and ultramafic rocks (Zinkevich et al., 1985, Raznitsyn et al., 1985; Fedorchuk, et al., 1989, Fedorchuk, 1992, Bojarinova, 1999, Bojarinova, 2002).

Ophiolite fragments of the Kamchatka Mys Peninsula (see Fig. 1) consist of the gabbros of the Olenegorsk Massif, ultramafic rocks of the Mount Soldatskaya, various basalts, and jasper and calcareous cherts of Aptian-Cenomanian age (the Afrika Group), as well as tholeiitic basalts and argillites of the Paleocene-Eocene Kamensky Complex. These form distinct thrust sheets in nappe structures of the southern Afrika block (see Fig. 1).

The northern part of the Kamchatka Mys Peninsula, the Stolbovskoy block, hosts island arc tholeiites and boninites (Lower Tarkhovkaya Subformation) that compose the lower part of the Late Maestrichtian-Eocene tuffaceous sedimentary group (Khotin, 1976, Zinkevich et al., 1985, Khubunaya, 1987, Fedorchuk, et al., 1989, Fedorchuk, 1992, Bojarinova, 1999).

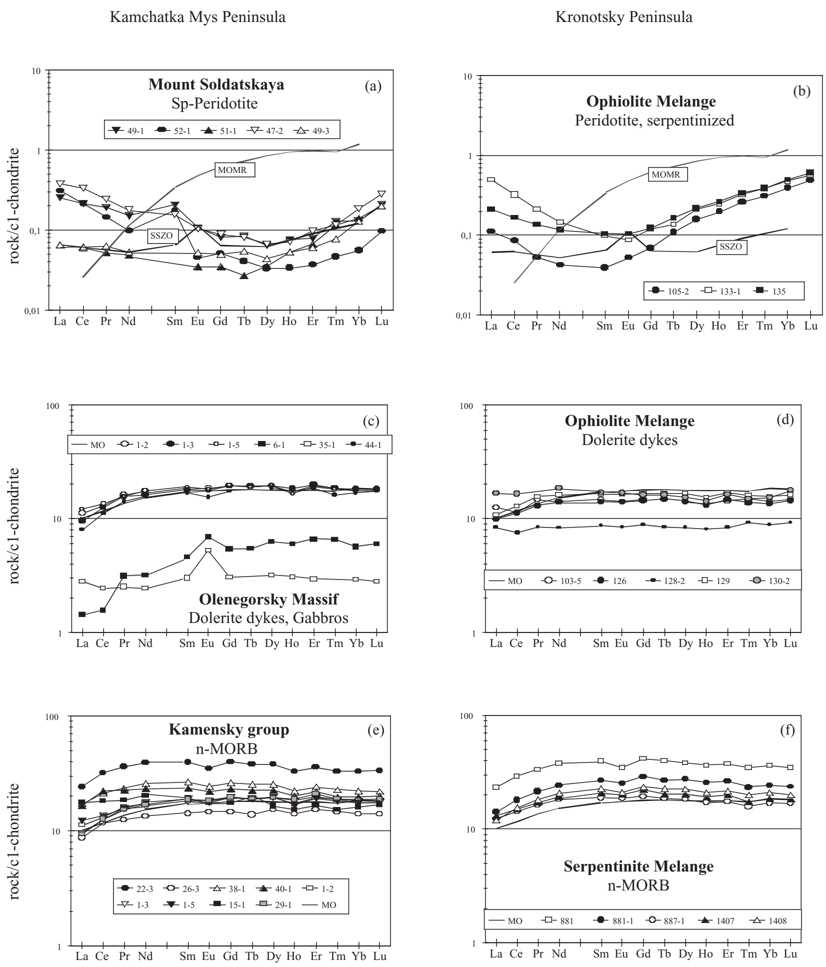

Figure 2. REE distribution patterns comparing peridotites (a,b), gabbros, dolerites (c,d), and basalts (e,f) of ophiolite members from the Kamchatka Mys Peninsula (a,c,e) and of the peridotite mélange from the Kronotsky Peninsula (b,d,f). C1-chondrite normalisation according to Evensen et al. (1978). MOMR: Mid Ocean Ridge mantle residues of the internal Ligurides (Rampone et al. 1996). SSZO: Supra-subduction Zone ophiolitic peridotite (Kay & Senechal 1976). MO: N-Type MORB average according to Sun & McDonough (1989).

The ophiolites of Kronotsky Peninsula are represented mainly by serpentinite mélange including peridotite, gabbro, dolerite, basalt, amphibolite, plagiogranite, rodingite and ophicalcite blocks. A massif of serpentinized harzburgites (c. 12 km^2, up to 300 m thick) with dunite lenses was mapped by Raznitsyn et al. (1985), Khubunaya (1987), and Bojarinova (2002). A thrust sheet of serpentinite mélange separates volcanogenic-tuffaceous island arc complexes of the Upper Cretaceous Kamenistskaya Subformation and of the Eocene Kronotskaya Formation. Pebbles of serpentinized peridotite were found in tuffaceous conglomerates of the Kronotskaya Formation in the mouth of Ushchelye River (Raznitsyn et al., 1985).

The Upper Cretaceous rocks of Kamenistskaya Subformation (K_2cn-km-m) and Kronotskaya Formation (P_2) consist of pillow basalts and lava flows alternating with hyaloclastic rocks, various tuffs, tuffites and tuffaceous silicites. According to Khubunaya (1987) the basalts are dominantly high-Al plagio-tholeiites.

Mineralogical and geochemical comparison of the ophiolites of the Kronotsky and Kamchatska Mys peninsulas

Ultramafic rocks of the Mount Soldatskaya are represented mainly by clinopyroxene-bearing harzburgites. Their mineral composition does not vary along a section of about 400 m length and is as follows: Cpx (Fs_{3-4}): Cr_2O_3 = 0.6-0.9% . Al_2O_3 = 1.5-2.0%; Opx (Fs_{8-9}): Cr_2O_3 = 0.5-0.6%, Al_2O_3 = 1.5-1,8%; Ol ($Fo_{90,9-91,7}$); Spl: Cr# = 47-61, Mg# = 35-40. The analyzed ultramafic rocks have mostly very low REE element contents: La_n = 0.065 and 0.3-0.4, Eu_n = 0.035-0.09, Lu_n = 0.1-0.22. The distribution of these elements is charac-

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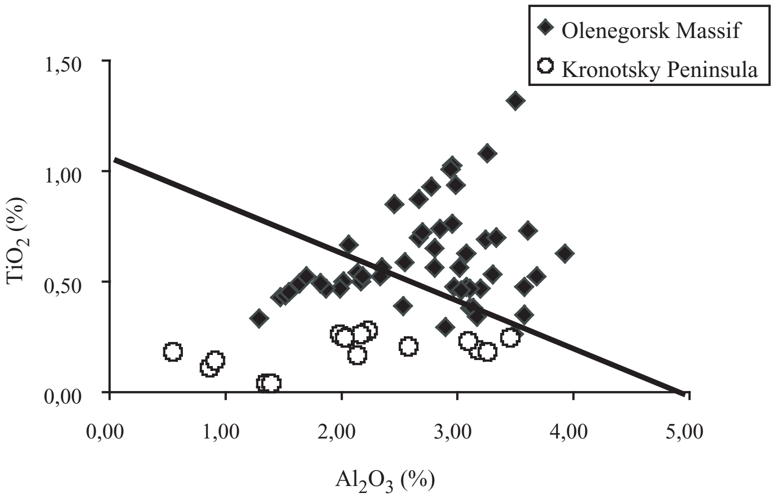

Figure 3. TiO_2 vs. Al_2O_3 plot for clinopyroxenes from gabbroids. The line dividing areas of clinopyroxenes from midoceanic (upper) and island arc (lower) gabbroic plutons in based on Zlobin and Zakariadze (1993).

terized by depletion of MREE (Medium REE) and partly of LREE (Light REE) in comparison with HREE (Heavy REE): $(La/Eu)_n$ = 1.3-4, $(Lu/Eu)_n$ = 2-5. These REE patterns are nearly congruent with those of the Troodos supra-subduction zone ophiolite (Fig. 2a).

Harzburgites of the Kronotsky Peninsula are strongly serpentinized, and primary minerals remain as relics with the following compositions: Cpx (Fs_{4-5}): Cr_2O_3 = 1.02-1.34%, Al_2O_3 = 3.39-4.60%; Opx (Fs_{10-11}): Cr_2O_3 = 0.63-0.81%, Al_2O_3 = 3.33-3.70%; Ol: Fo_{90}; Spl: Cr# = 23-32, Mg# = 67-70. Compared to the mineral compositions of the harzburgites of the Mount Soldatskaya, the pyroxenes contain much more Cr and Al whereas spinel has generally less Cr but more Mg.

The REE distribution patterns from La to Gd in the above-mentioned harzburgites is similar to that of ultramafic rocks from Mount Soldatskaya, however the Tb to Lu values are significantly higher as documented by $(La/Eu)_n$ = 2-5, $(Lu/Eu)_n$ = 5.5-9 and Fig. 2b.

Pyroxene gabbros prevail among the gabbros of the Olenegorsk Massif and are composed of Cpx (Fs_{10-15}): TiO_2 = 0.54-0.93%, Cr_2O_3 = 0.08-0.30%, Al_2O_3 = 2.70-2.80%; Opx (Fs_{29}): TiO_2 = 0.35-0.74%, Cr_2O_3 = 0.04-0.05%, Al_2O_3 = 1.30-1.50%; Pl (An_{55-63}). The REE distribution in pyroxene gabbro is similar to that for cumulates which crystallized from tholeiitic melts of N-MORB type: $(La/Sm)_n$ = 0.3-0.9, La_n = 1.5-2.8, Sm_n = 3-4.5, Lu_n = 2.8-6, with a strongly positive Eu anomaly (Fig. 2c).

The clinopyroxene composition of the fine-grained gabbro from blocks of the serpentinite mélange of Kronotsky Peninsula was determined to be $Fs_{12-20,}$ TiO_2 = 011-0.26%, Al_2O_3 = 0.87-2.09%, Cr_2O_3 = 0.06-0.24%, with plagioclase An_{60-80}. These clinopyroxene compositions fall into the field of clinopyroxenes from supra-subduction gabbros based on the concentrations of Ti and Al in diagrams by Zlobin and Zakariadze (1993) (Fig. 3).

The dolerite dykes of the Olenegorsk Massif derive from N-type MORB depleted melts based on REE distribution of $(La/Sm)_n$ (= 0.4 - 0.6). They are complementary to the analysed gabbros as shown by high absolute REE concentrations (15-20 times chondrite norms) and a weak negative Eu anomaly. Basalts of the Afrika and Kamensky complexes have REE compositions similar to that of dolerites ($(La/Sm)_n$ = 0.4-0.7) (Fig. 2c and e).

Tholeiitic basalts found in the serpentinite mélange of the Kronotsky Peninsula are, according to their geochemical characteristics (see Fig. 2f), similar to N-type MORBs.

Discussion and conclusions

According to the presented mineralogical and geochemical criteria, the rock samples analysed in this study are related to several ophiolite complexes of different origin.

The peridotites of Kamchatka Mys and Kronotsky Peninsulas, according to their mineral composition and geochemical characteristics, represent restites from partial melting of more or less depleted mantle. However, the reported data also suggest that the geodynamic conditions of melting were different among these different ophiolite assemblages.

The spinels in peridotites from Mount Soldatskaya are very Cr-rich and, in fact, they lie outside the compositional field characteristic of oceanic peridotites (Fig. 4) (Bonatti et al., 1992). The Cr_2O_3/Al_2O_3 ratio in pyroxenes from these samples fall into the field defined by peridotites of the Mariana Trough (Bloomer and Hawkins, 1983). The comparison of REE distributions in different parts of the Kamchatka Mys ophiolite section with samples from the Troodos ophiolites shows good correlation (Kay, 1976). The ophiolites of Troodos type are interpreted as formed in supra-subduction setting. According to Shervais (2001), on the Kamchatka Mys Peninsula only Upper Cretaceous-Early Paleocene boninites and island arc tholeiites (comprising the Lower Tarkhovskaya Subformation of the Stolbovsky Block) derive from the sampled peridotites. Consequently, we infer that the peridotites of the Mount Soldatskaya ophiolite have a partial melting signature indicating Upper Cretaceous age.

The mineralogy of peridotites of the Kronotsky Peninsula is close to moderately depleted restites, widespread in mid-ocean ridge areas

(Bonatti et al., 1992). The most characteristic features here are the Cr# of spinels and the Al_2O_3 contents of orthopyroxenes (Fig. 4).

The REE patterns of the peridotites of both the Kronotsky Peninsula and the Mount Soldatskaya Massif reflect elevated LREE concentrations, typical of cryptic metasomatic overprinting under supra-subduction conditions (Kay and Senechal, 1976, Bloomer and Hawkins, 1983). The L-, M- and HREE contents of Mount Soldatskaya peridotites may be explained by additional partial melting due to introduction of water released from a subducting slab (after Bonatti and Michael, 1989). These rocks may represent a typical supra-subduction zone (SSZ) peridotite. The elevated M- to HREE contents of the Kronotsky Mélange peridotites fall into an intermediate position between SSZ ophiolites and MOR mantle residues (Rampone et al. 1996), cf. Fig. 2b. This might be interpreted either as a hint at an early history of those rocks in a back-arc basin or in a MOR environment before it became a supra-subduction area.

From our point of view the high contents of Al_2O_3 in spinel and orthopyroxene may be connected with the fact that spinel and pyroxene, which re-crystallized during partial melting, were in equilibrium with high-Al or high-(Al,Fe) basaltic melt.

All known Kronotsky Peninsula basalts are high-Al plagio-tholeiites. S. Khubunaya (1987) suggests that the parental melts of these basalts also were rich in Al. Therefore, a petrogenetic connection between high-Al basalts and peridotites from the serpentinite mélange and the involvement of these peridotites in subduction-related magmatic processes are very likely. According to geological data and to the geochemical imprint of high-Al basaltic melt generation in the ultramafics, the harzburgites of the Kronotsky Peninsula may have Mid- to Late Cretaceous age (see above).

The gabbros of the Olenegorsk Massif contain xenoliths analogous to peridotites of the Mount Soldatskaya complex, which were influenced by partial melting. Consequently, the gabbros of the Olenegorsk Massif could not have formed earlier than the peridotites of the Mount Soldatskaya complex, i.e., not earlier than Upper Cretaceous. According to geochemical criteria, the tholeiitic basalts of both the Aptian-Cenomanean Afrika Complex and the Paleocene to Early Eocene Kamensky Group may be derived from the same melts as those from which gabbros and dolerites of the Olenegorsk Massif were formed. However, if we accept that the gabbro massif is not older than Upper Cretaceous, then the upper member of this ophiolitic complex may be comprised of only Paleocene to Early Eocene basalts.

Thus, gabbros and dolerites of the Olenegorsk Massif and basalts of Kamensky Complex form another ophiolite complex of approximately Middle Eocene age. According to the geochemical criteria it may have formed in either (or both) a mid-ocean ridge or a back-arc setting. However, taking into account the geological relations it seems likely that this complex was formed along a spreading center in close vicinity to a volcanic arc or (after migration) directly in the arc. In this case N-type MORB tholeiitic basalts from the Aptian-Cenomanian Complex (Afrika Group) belong to the oldest ophiolite complex. Most likely they represent a fragment of an oceanic plate and were formed in a mid-oceanic ridge environment.

The basalts from the serpentinite mélange found on the Kronotsky Peninsula are related to N-MORB type oceanic tholeiites, according to their geochemical characterisitcs. They could have formed either in mid-ocean ridge conditions or in a back-arc spreading center. However, there are no direct geological data indicating that back- or intra-arc spreading could have taken place in Paleocene-Eocene time on the Kronotsky Peninsula. As far as the Kronotsky and Kamchatka Mys Peninsulas are parts (terranes) of a single island arc and taking into account the geochemical similarity of these basalts and of the Aptian-Cenomanian basalts (Afrika Group) of the Afrika Block from the Kamchatka Mys Peninsula, we suppose that these basalts also have Aptian-Cenomanian age and were formed in a mid-oceanic ridge setting.

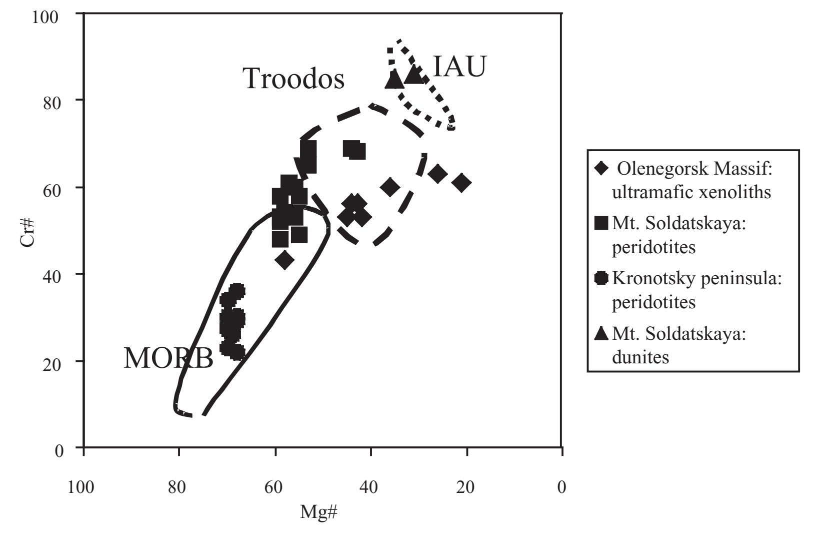

Figure 4. Cr_2O_3 vs. Al_2O_3 plot for spinels from ultramafic rocks. Areas: MORB (after Bonatti and Michael, 1989), Troodos (after Kay and Senechal, 1976), IAU (Island Arc Ultramafics, after Bloomer and Hawkins, 1983)

International Research: Ophiolites: Skolotnev et al., cont...

Our results show that different segments of the Kronotsky paleoarc originated and developed under different geodynamic conditions, which changed over geologic time. In the northern (Kamchatka Mys) segment a nearly complete ophiolite succession can be mapped, and in the southern segment only the Kronotsky serpentinite mélange that intruded (by thrust faulting) the upper crustal horizons has been discovered. The Kronotsky paleoarc formed on oceanic basement represented by (likely) Aptian-Cenomanian tholeiitic basalts and pelagic sedimentary deposits. These sedimentary rocks were most likely deposited at a mid-ocean ridge.

Later on, during the Late Cretaceous, boninites and tholeiitic basalts of the Kamchatka Mys segment were generated by partial melting of peridotites in the arc basement, and on the Kronotsky segment tholeiitic high-Al basalts were emplaced. The Tertiary history of these segments is also variable: during Paleocene to Early Eocene, dolerites and basalts were derived from oceanic tholeiitic melts of intra- or back-arc nature (Kamchatka Mys Peninsula) and in the south the intensive high-Al basalt volcanism continued (Kronotsky Peninsula).

Acknowledgements

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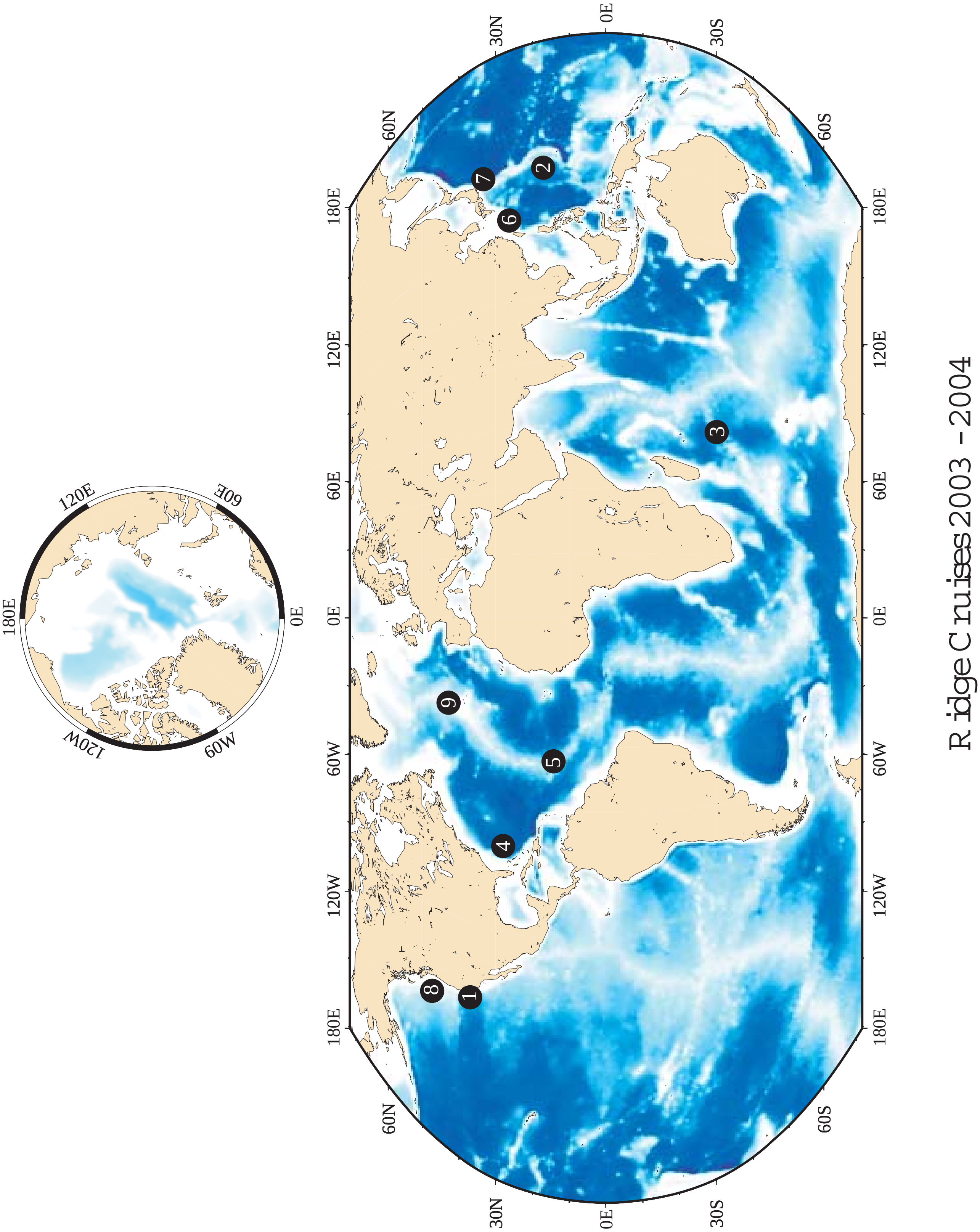
Editor's Note

World Ridge Cruise Map, 2003-2004

A listing of international ridge cruises, compiled by Daniel Curewitz can be found on the following pages. Each cruise is coded with a number, which represents it's location on the map below. The list of world cruises is organised by date. Please submit scheduled and upcoming cruises by filling in the online form at: http://www.intridge.org/cruisefm.htm



World Ridge Cruise Schedule, 2003 -2004, continued…

Map No.	Country	PI	Institution	Cruise ID/Location	Research Objectives	Ship	Dates
1	USA	Voight	Field Museum	Gorda Ridge Monterey Fan Valley seeps	Biological collections at vents and seeps, chemical and geological studies, mapping	Atlantis Alvin	2003
2	Japan USA	Ohara	Hydrogr. Dept. Japan	Parece Vela Basin, Phillipine Sea	Comprehensive petrological investigation of the Parece Vela backarc basin amagmatic spreading center. 25 to 30 dredge hauls.	Karei	Jan 6 - Jan 25, ’03
3	USA	Dick Lin	WHOI	Southwest Indian Ridge	Rock dredging and geophysical studies to investigate the influence of ridge geometry on cresutal accretion and mantle structure of an ultra-slow spreading ridge	Melville	Jan 19 - Feb 9, ’03
4, 5	France	Cosson Lallier	ISOMer Roscoff	MALABAR/MAR (Logatchev), Barbados (Orinoco-El Pilar)	Sampling of microbes to study their biodiversity and adaptations to hydrothermal vents and cold seeps.	L’Atalante Nautile	Mar 12 - Apr 8, ’03
5	USA	Dziak Smith	NOAA WHOI	Mid Atlantic Ridge (10 -35 N)	Deploy and recover autonomous hydrophones monitoring seismicity along the northern Mid Atlantic Ridge	Maurice Ewing	Apr 17- May 14, ’03
5	Germany	Herzig	Freiberg	HYDROMAR, MAR 15 N	ROV investigations of hydrothermal and biological interactions in ultramafic hosted hydrothermal systems	Meteor	Jan 15 - Feb 13, ’04
5	USA	Reves-Sohn Humphris Canales	WHOI	Mid-Atlantic Ridge, 26 N TAG segment	Install long-term seismic and exit fluid temperature instrument networks	Atlantis	June 11- June 28, ’03
6	Japan	Nunoura	JAMSTEC	Okinawa Trough	Microbiological studies of hydrothermal sites using Shinkai 6500 submersible	Yokosuka Shinkai 6500	Jul 1- July 18, ’03
6	Japan	Inagaki	JAMSTEC	Okinawa Trough	Microbiological studies of hydrothermal sites using ROV Hyper-Dolphin	Natsuhima Hyper-Dolphin	Aug 12- Sept 6, ’03

World Ridge Cruise Schedule, 2003 -2004, continued...

Map No.	Country	PI	Institution	Cruise ID/Location	Research Objectives	Ship	Dates
2	Japan	Takai	JAMSTEC	S. Mariana Trough	Microbiological studies of hydrothermal sites using Shinkai 6500 submersible	Yokosuka Shinkai 6500	Aug. 19- Sept. 19, ’03
7	Japan	Matsuyama	JAMSTEC	Y03-07 Japan Trench Cruise: Japan Trench	Genome analysis of the symbiotic bacteria of molluscans that grow in chemosynthesis-based environments	Kairei Kaiko	Aug. ’03
8	USA	Chadwell	SIO UCSD	South Cleft Segment, Juan de Fuca Ridge	Deploy system for continuous (daily) measurements of acoustic range across (~ 1-km wide) axial valley floor.	Revelle	Sept. 4 - Sept. 20, ’03
9	France, US, Portugal	Goslin	CNRS Brest	SIRENA-2/D274 North Atlantic	Recovery (or turn-over) of six autonomous hydrophones moored in the SOFAR channel to record signals from MAR earthquakes occuring north of the Azores	Discovery	Sept. 11 - Oct. 5, ’03
2	Japan	Utsumi	Tsukuba	S. Mariana Trough	Geochemical studies of hydrothermal sites using Shinkai 6500 submersible	Yokosuka Shinkai 6500	Oct. 14- Nov. 14, ’03
2	Japan	Deschamps, Fujiwara, Tokuyama	JAMSTEC ORI	MICRO-MAR Central Mariana Trough	High resolution side-scan (Wadatsumi) of the Mariana Trough spreading axis.	Kairei Wadatsumi	Oct. 22 - Nov. 14, ’03
5	Germany UK	Devey Rhein	U Bremen, SOC U Hamburg Freie U GEOMAR	MAR 2 -11 S	Detailed bathymetry and side-scan (TOBI) of the MAR. Locating and exploring hydrothermal sites with BRIDGET, CTD, and new Bremen 4000m ROV	Meteor	Nov. 9 - Dec. 30, ’04
2	Japan	Ishii	ORI	HH03-3, Mariana Arc-Parece Vela Rift	Rock sampling in the southern Mariana forearc and backarc regions. Geophysical mapping of the amagmatic Parece Vela Rift.	Hakuho	Nov. 11 - Nov. 28, ’03
7	Japan	Nishizawa	JAMSTEC	Bonin Arc	Geophysical studies of hydrothermal sites using ROV Kaiko	Kairei Kaiko	Dec. 12- Dec. 26, ’03
5	Germany	Reston	GEOMAR	MAR 8 S Ascension Fracture Zone	Wide-angle seismic refraction and reflection, microseismicity and tomography.	Meteor	2004

National News....

Canada: CanRidge

Special collaborative funding for the CanRidge program began its final year on April 1, 2003. Focus in 2003/2004 will be on completing sampling and field experiments at Axial Volcano and Endeavour Segment on the Juan de Fuca Ridge. Work will begin in a collaborative cruise to Endeavour Segment (July 27 – August 25) with the University of Washington during which the ROPOS submersible will be deployed from the R/V Thomas G. Thompson. A second cruise with ROPOS on the Thompson will be led by collaborators from the NOAA Vents program. Fieldwork objectives for the two cruises include:

1) Microbiology of weathering sulphides - We will extensively sample decaying sulphide chimneys and associated microorganisms from a small extinct vent field on Endeavour Segment. One project will evaluate microbial abundance and community composition in relation to weathering state of the sulphides, following up on work conducted at Explorer Ridge in 2002. Other microbial diversity studies will include molecular investigation of both viral and bacterial populations as well as culturing for phototrophs (mostly yellow-pigmented) and metal resistant strains.

2) Effects of vestimentiferan worm tubes on sulphide chimney mineralisation - We have selected a fast growing sulphide edifice in the Main Endeavour vent field for sampling and nearby deployment of larval colonisation experiments. A graduate student will examine texture and mineralogy of sulphides colonised by vestimentifera (versus uncolonised surfaces) to quantify the effect of fossil tubes on bulk porosity and permeability, and to characterise them mineralogically. Analysis of the relative size of fossil vestimentiferan tubes in relation to surrounding mineralogy will feed back to colonisation studies by providing information on the relationship of recruitment success (large tubes) and failure (small tubes only) to mineralisation processes following settlement.

3) Habitat allocation among the common gastropods at northeast Pacific hydrothermal vents - The limpet Lepetodrilus fucensis numerically dominates most vent assemblages in the region, and is responsible for major successional transitions. Research is focusing on understanding the biology of this species in different habitats to learn what characters allow it to achieve such ecological success. Patterns in faunal recruitment of the limpet (and other gastropods) will be examined in summer 2003 by deploying a sediment trap designed to take discrete monthly samples of settling larvae.

4) Larval supply and recruitment - Short term deployments of passive larval traps will be used to evaluate larval supply in relation to location. Synoptic larval abundance in the water column immediately above and away from vents will be determined in sampling operations where the submersible deploys nets and operates filtration pumps while flying a grid pattern over vent fields and control sites. Recruitment will be studied through deployment of arrays of natural (basalt) and artificial (scour pads) substrates on the seafloor. Arrays deployed in 2001 and 2002 will be recovered from both Axial Volcano and Endeavour Segment, and new arrays will be deployed at Endeavour.

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Marine Protected Areas in Canada

University of Qubebec, Endeavour hot vents area:
http://www.er.uqam.ca/nobel/oasis/

Marine Protected Areas programme:
http://www.dfo-mpo.gc.ca/oceanscanada/newenglish/htmdocs/mpas/endeavour.htm
http://www.pac.dfo-mpo.gc.ca/oceans/mpa/pilots.htm

The Remotely Operated Platform for Ocean Science: http://ropos.com/

National News....

Germany: DeRidge

The German Ridge community had a hectic last few months with the deadline for submission of proposals to the new DFG priority programm arriving at the end of March, shortly before the joint EGU-AGU meeting in Nice. Some 26 proposals were submitted to the DFG seeking funds to support work in the two chosen German Ridge study areas of 14 – 15°N and 4 – 11°S in the Atlantic. Many of the proposals involved using the new Bremen ROV (all-electric ROV from Sea-Quest, depth capability 4000m, first scientific sea trials in June 2003) in conjunction with cruises planned with the R/V Meteor next year (Jan. – Feb. 2004, P.I.: Peter Herzig; Oct. – Nov. 2004, P.I.: Tim Reston; Nov. – Dec. 2004, P.I.: Colin Devey). The Ridge community was also successful in securing in principle (pending approval of the cruise plans) ship time for follow-up studies in the two areas in 2005. The German Ridge activities then culminated, for the present author at least, in the submission of a bid to host the InterRidge Office in Germany for the period 2004 – 2006. All of these activities underline the strength of ridge research at present in Germany, the commitment of the Ridge community here to InterRidge, and the strong interest of the Bremen group and Bremen University in hosting the IR office.

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http://www.Ozeankruste.de/DeRidge/deridge.html

Principle Themes for InterRidge Next Decade Science plan will include:

Ultraslow-spreading Ridges
Ridge-Hotspot interactions
Back-arc Spreading Systems/Back-arc Basins
Mid-oceanic ridge Ecosystems
Monitoring and Observatories
Deep Earth Sampling
Global Exploration

Visit the IR website to download a copy of the draft ND plan.

http://www.intridge.org/irnd.pdf

National News....

France

The Dorsales program has ended in 2001. A new organisation of programs in Earth Sciences is being discussed at CNRS. Among the new potential programs, two are of major interest to the Dorsales community. The first one, "Dynamics and Evolution of the Internal Earth", will cover general issues about accretionary processes at mid-ocean ridges such as mantle convection, melting, lithosphere mechanics, hotspot/ridge interaction etc.... But the ridge community will not be identified and will be merged with the other Earth science communities. Moreover, biology is clearly not involved. The second one is based on the InterRidge MOMAR initiative, and its aim is to develop long term observations and measurements on the MOMAR site, south of the Azores on the Mid-Atlantic ridge. This program is multidisciplinary, combining efforts in geophysics, geology, geochemistry, water chemistry and biology. It should help maintain a coherence in the French ridge community and should be the correspondent for InterRidge. IFREMER has also expressed an interest in developing long term measurements on the seafloor. Funds are being sought from the European Community to support part of this program, the target being located in the Portuguese waters. Finally, the CNRS multidisciplinary program on "Geomicrobiology of the Extreme Environments" (GEOMEX), initiated in 2001, will continue and should cover aspects of geomicrobiological interactions at mid-ocean ridge hydrothermal fields.

This new general scheme may still be adjusted before its implementation. Moreover, due to severe cuts in research budgets in 2003, the two new programs are not likely to start in 2003, but rather in 2004. Meanwhile, CNRS has agreed to continue paying the InterRidge contribution till the end of the program. For the InterRidge New Decade Initiative, the signals from CNRS are quite positive at present. The final decision will depend on the future of the MOMAR program.

In 2003, due to cuts in the IFREMER budget but also to the mobilisation of the Nautile on the PRESTIGE wreck, the science program for the research vessels has been substantially reduced. Of the 4 cruises initially planned only two will actually be scheduled:

-Luckyflux (P.I.: A. Bonneville): Regional heatflux measurements in the MOMAR area

-SIRENA II (P.I.: J. Goslin): recovery of hydrophones installed in 2002 to monitor the seismicity of the MAR, North of the Azores.

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Previous updates from France can be found at:
http://www.intridge.org/fra.htm

Universities & Research Institutions in France

French Reserach Institute for Exploration of the sea
http://www.ifremer.fr/anglais/
Institut de Physique du Globe de Paris (IPGP)
http://www.ipgp.jussieu.fr/index3.html
European Institute for Marine Studies
http://www.univ-brest.fr/IUEM/index_uk.htm

National News....

InterRidge - Japan

ORI vessels move to JAMSTEC

The R/V Hakuho-maru (4000 ton) and R/V Tansei-maru (600 ton) of Ocean Research Institute, University of Tokyo have been the main academic fleet of Japanese ocean research activities for the last 35 years. From April 2004, both vessels will move to more enhanced cruise operations. Though currently both research vessels are operated with 180 days a year each, the number of operational days will be increased to 300 days a year for each vessel with an additional budget after moving to JAMSTEC. Ocean Research Institute will continue to be in charge of cruise planning of the two vessels while JAMSTEC will take charge of operating the vessels. Ocean Research Institute will set up a new committee for cruise planning, who will review and evaluate the submitted science cruise proposals.

The 2nd phase of Archean Park project

The Archaean Park project (P.I.: T. Urabe), the largest funded ridge research program in Japan, is in its second phase for FY 2003 and FY 2004. The main purpose of the second phase is to search for and characterise unknown sub-seafloor biosphere at hydrothermal active sites in the southern Mariana Trough, western Pacific Ocean. In this area, little is known about microbiological features below the seafloor, though there is evidence from previous studies for the existence of high temperature fluid venting at several locations along back arc spreading centres and arc volcanic chains. Comparison between the southern Mariana Trough and Suiyo Arc Seamount (the main target of the first-phase of the project where some new microbes, including archaea, have been discovered) will be noteworthy from microbiological and geochemical view points

Four cruises are planned this fiscal year for the Archaean Park Project. Firstly, diving surveys with the Shinkai 6500 and R/V Yokosuka (P.I.: Motoo Utsumi, Tsukuba Univ.) will be conducted from 14th October to 14th November, chiefly along the back arc spreading centre of the southern Mariana Trough, where the previous survey by the NOAA/PMEL cruise by R/V Thomas Thompson (P.I. Robert Embley) in February and March 2003 found strong anomalies of light transmission. It is expected to locate active hydrothermal sites for sampling and in situ experiments to characterise sub-seafloor biosphere. Secondly, surveys using the R/V Kairei (P.Is: T. Yamazaki and H. Masuda) will follow from 17th November 2003 to 8th December 2003. During this cruise, extensive studies on hydrothermal activity and plumes will be performed by CTDT-hydrocasts, electromagnetic surveys, sampling with rock dredges etc. Thirdly, a BMS drilling cruise will be conducted using the R/V No.2 Hakurei (P.I.: T. Urabe) from January ~25th to February ~13th, 2004, and finally the, Suiyo Seamount will be revisited by the ROV Kaiko and R/V Kairei (P.I.: A. Nishizawa) from 13th to 26th December, 2003.

Some of the results of the first-phase research were presented at the 2002 AGU Fall Meeting (sessions V72A and V11C). Special sessions on the Archaean Park Project will be held during the 2003 Goldschmidt conference at Kurashiki, Japan (September 7th to 12th), and during the 2003 AGU Fall Meeting at San Francisco (December 8th to 12th).

Riser-drilling vessel, "Chikyu", is under construction

The new riser-drilling vessel "Chikyu" is now being constructed by JAMSTEC. On January 18, 2002, the naming and launching ceremonies for Chikyu were held in Tamano, Okayama. In May 2003, Chikyu moved to Nagasaki for its final construction of derrick and other facilities for the drilling. Chikyu will add a significant contribution for the ridge-related studies under the new IODP framework that officially starts in October, 2003. In 2002, CDEX (Center for Deep Earth Exploration) of JAMSTEC carried out pre-drilling site surveys for Chikyu training cruises, the first real operation of OD21 program.

Kensaku Tamaki,
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Previous updates from Japan can be found at:

http://www.intridge.org/japan.htm

National News....

USA: R2K

In the past year, the focus of the Ridge 2000 (R2K) program has moved from planning and design to implementation. Twelve of the 30 proposals submitted for the August 2002 NSF target date were recommended for funding and the field efforts associated with the funded proposals will begin in 2004. An additional 23 proposals were submitted for the February 2003 target date and we are hoping for a similarly high success rate for those proposals.

The R2K Program Steering Committee met in late April 2003 to review our progress, evaluate our needs, and make plans for the future. Five subcommittees were ratified at that meeting, although all were already functioning as a result of the efforts of their respective Chairs. Oversight committees were formed for each of the three initial Integrated Study Sites (ISS). The Lau Basin ISS committee is chaired by Douglas Weins, the Endeavour Segment ISS committee by David Butterfield, and the 8°-11°N East Pacific Rise ISS committee by Suzanne Carbotte. Jim Cowen is chairing the oversight committee for the Time Critical Studies component of the program. We also formed a Data Committee that is charged with generally overseeing and fostering data management for the R2K program. This subcommittee, chaired by Charles Langmuir, will work closely with the R2K Data Management Office when it becomes operational. Contact information for all of the committee chairs is available on the Ridge 2000 Web page (http://ridge2000.bio.psu.edu). All five chairs are members of the R2K Steering Committee.

Detailed updates on each of the initial ISS are in the first issue of Ridge 2000 Events (April 2003), which is available on the R2K Web site. If you prefer a hard copy of the program newsletter, please contact the R2K office (ridge2000@psu.edu). Intensive research at the EPR and Endeavour ISS has been ongoing for many years, and the newly funded programs will begin to ramp up the interdisciplinary and interlinked studies to the level necessary to achieve the goals of the implementation plans. The Lau Basin ISS on the other hand has a much more limited record of previous and ongoing studies. However, five large multi-PI proposals were recommended for support to initiate R2K work and choose the "bull's-eye" vent field for the Lau Basin ISS. These studies will commence as a multileg expedition in spring or summer of 2004, and will rapidly advance our understanding and future R2K investigations at this ISS.

To maintain the momentum of the program, evaluate our progress toward the goals of the implementation plans, identify any remaining gaps in the range of planned studies, and begin the integration of the already funded studies, the Ridge 2000 program will host an open workshop in Boulder, CO, 7-8 November, 2003. All interested ridge researchers are welcome to attend, and we would especially welcome international attendees with previous experience or plans for work at any of the three initial ISS.

Coordination of efforts to share ridge science with the education community and general public has also begun. Our Education and Outreach (E&O) coordinator, Liz Goehring, in collaboration with an advisory committee and a selection of expert educators, have defined the E&O goals and a set of proposed projects aimed at three target groups (the scientific community, younger students and their teachers, and the general public). Outreach to the scientific community will continue through conferences, articles, our Web site and newsletters, and the addition of a new Ridge 2000 Lecturer Series that will debut in early 2004. This lecture series will also have a component geared toward the general public. For the secondary education community, a large multiyear effort has begun. This integrated Ridge Science Education Program is targeted at middle and high school audiences (ages 12-18 years old) and will include curriculum modules, Web coverage of research cruises during the academic school year, student participatory projects, teacher professional development, and distance education courses. We are also exploring collaborations with various filmmakers for some high visibility films to share ridge science with the general public. We are excited about the real progress we are making in the area of education and outreach and are always looking for input and ideas. Check our Web site for more details on our E&O plans and by all means contact Liz (exg15@psu.edu) if you have any ideas or want to get involved!

Finally, we are pleased to announce that Sharon Givens has accepted the position of Program Coordinator in the Ridge 2000 office, replacing Deborah Hassler, who moved to work with ExxonMobil in Houston, TX (congratulations Debbie!). Sharon has degrees in both Journalism and Geology, with considerable editorial and publication experience, and is an excellent addition to the team.

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National News....

Korea

The first phase of Daeyang Program by Korea Ocean Research and Development Institute (KORDI) ended this year (2000-2003). During the three years of this program several important achievements have been made. In May of 2000 and 2001, a section of plate spreading boundary located at the southern Philippine Sea, known as Ayu Trough, was mapped using multibeam bathymetric echosounder and underway geophysical tools and was sampled using dredge and piston corer. The new detailed bathymetric map revealed that Ayu Trough is an oblique spreading segment, and thus our previous model of the Philippine Sea plate motion with respect to Caroline plate may have to be changed. In addition, geochemical analysis has been performed on the dredge rock samples collected along the axis of the Ayu Trough, and so far major, minor and trace element measurements have been completed.

In September 2002, KORDI conducted geological and geophysical surveys at three locations around Papua New Guinea. The three sites include:

1) submarine seamounts around the Lihir Island in the New Ireland forearc basin, where multichannel seismic profiles were obtained;
2) hydrothermal vent fields in the eastern Manus basin, including SuSu Knolls, DESMOS and PACMANUS; and
3) western Bismarck Sea near the East Schouten Islands where the boundary between northern and southern Bismarck microplates is thought to cross but is not well defined.

One of the important highlights of last year's survey was the successful deployment of a deeptow proton precession magnetometer over the PACMANUS vent sites, which was flown 100-150 m above the seafloor. The new magnetic field data, together with the results from rock magnetic analyses on samples collected by recent ODP Leg 193 drilling, may allow us to better define the extent of hydrothermally affected region of the seafloor and understand the alteration of magnetic minerals.

Last year the Korean government approved the budget of approximately 85M USD for construction of a new vessel to support research in the polar regions. Together with the existing R/V Onnuri, the new research vessel will allow Korean scientists to participate in many more open sea research cruises in the years to come. Much of 2003 will be spent by KORDI scientists in planning for the second phase of Daeyang Program, which will require a larger budget and will be more focused in its scope than the first phase. Finally, we believe that 2004 will be an exciting and busy year as Korea will be the host of the RIDGE 2000-InterRidge Joint Theoretical Institute (R2K-IRTI): Interactions among Physical, Chemical, Biological, and Geological Processes in Backarc Spreading Systems. See the back of this issue for detaails.

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Previous updates from Korea can be found at:
http://www.intridge.org/kor.htm

Upcoming Meetings and Workshops

Calendar of MOR Research related events

More details about all of the following meetings can be found via the Meetings menu on the InterRidge homepage:
http://www.intridge.org/info3.html

7-11 April, 2003	EGS-AGU-EUG Joint Assembly, Nice, France
14-16 April, 2003	Charting the Secret World of the Ocean Floor. The GEBCO Project 1903-2003, Monaco
4-6 June, 2003	Oceanology International Americas, New Orleans, Luisiana, USA
16-18 June, 2003	Biogeography and Biodiversity of Chemosynthetic Ecosystems: Planning for the future, SOC, UK
TBA, 2003/2004	IR Workshop: Opportunities and Contributions of Asian Countries to the InterRidge Next Decade Initiative, Beijing, China,
23-26 June, 2003	Fluxes and Structures in Fluids, St. Petersburg, Russia
24-27 June, 2003	Scientific Submarine Cable workshop, Tokyo, Japan
27-28 June, 2003	IR Steering Committee Meeting, Tokyo, Japan
30 Jun.-11 Jul., 2003	International Union of Geodesy and Geophysics (IUGG), Sapporo, Japan
8-10 Sept., 2003	Ridge-Hotspot Interaction: Recent Progress and Prospects for Enhanced International Collaboration, Brest, France
22-26 Sept., 2003	7th International Conference on Gas Geochemistry, Freiberg, Germany
1-3 Oct., 2003	Interdisciplinary Studies if Slow- and Ultra Slow-Spreading Ridges: From Mantle Melting to Biota Formation at Hydrothermal Vents, Moscow, Russia
6-10 Oct., 2003	33rd Underwater Mining Institute, "New Horizons for Marine Mining: Progress through International Cooperation, Jeju Island, Korea
2-5 Nov., 2003	GSA Annual meeting, Seattle, USA
7-8 Nov., 2003	Ridge2000 Open community workshop, Boulder CO., USA
8-12 Dec., 2003	AGU 2003 Fall Meeting, San Francisco, USA
14-16 Jan., 2004	The fifth International Conference on Asian Marine Geology, Bangkok, Thailand
26-30 Jan., 2004	Ocean Sciences Meeting, Portland, OR, USA
16-19 Mar., 2004	Oceanology International, London, UK
25-30 April, 2004	"Minerals Of The Ocean - Integrated Strategies, St.Petersburg, Russia
26-30 April, 2004	European Geosciences Union (EGU) XXVIX General Assembly, Nice, France
17-21 May, 2004	Joint Meeting: AGU and the Canadian Geophysical Union, Montreal, Canada
24-28 May, 2004	R2K-IRTI: Backarc Basins and Spreading Systems, Korea
16-20 Aug., 2004	Western Pacific Geophysics Meeting, Honolulu, Hawaii
20-28 Aug., 2004	32nd International Geological Congress, Florence, Italy
13-17 Dec., 2004	AGU 2004 Fall Meeting, San Francisco, USA

Upcoming Meetings and Workshops

GSA Annaul meeting

Seattle, USA
2 - 5 November, 2003

http://www.geosociety.org/meetings/2003/top13.htm

Deadlines
Abstract submission: 15 July
Preregistrtion: 26 September

Relevant sessions
T135 Hydrothermal Alteration on Active Volcanoes: Processes, Rates, and Applications to Hazards and Resources
T136 Shallow Submarine Hydrothermal Vents: Geology, Geochemistry, and Biota
T137 Submarine Hydrothermal Systems: The Emergence of Geobiology

InterRidge Workshop:

Opportunities and Contributions of Asian Countries to the InterRidge Next Decade Initiative

Beijing, China, - postponed - new date TBA
http://www.intridge.org/beijing03.htm

ORGANISING COMMITTEE
John Chen (co-chair), Peking University, Beijing, China (johnyc@pku.edu.cn)
Jian Lin (co-chair), Woods Hole Oceanographic Institution, USA (jlin@whoi.edu)
Kensaku Tamaki, University of Tokyo, Japan
Sang-Mook Lee, Korea Ocean Research & Development Institute, Korea
Catherine Mevel, Universite Pierre et Marie Curie, France

OBJECTIVES
1) To promote active participation of Asian countries in the InterRidge program and to improve coordination of InterRidge research activities among Asian countries;
2) To bring together scientists from different disciplines to discuss unique contributions that Asian countries can make to the InterRidge Next Decade Initiative; and
3) To provide a forum for exchange of ideas and research results on a variety of subjects including oceanic crustal processes, back arc spreading ridges, hydrothermal systems, vent biology, and sub-seafloor biosphere.

WORKSHOP AGENDA
Available from the IR website:

Upcoming Meetings and Workshops

InterRidge Symposium and Workshop:

Ridge-Hotspot Interaction: Recent Progress and Prospects for Enhanced International Collaboration

8-10 September, 2003

Institut Universitaire Européen de la Mer
Université de Bretagne Occidentale, Brest, France

http://www.intridge.org/rhi03.htm

REGISTRATION DEADLINE: 20 July 2003

ORGANISNG COMMITTEE

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Agnieszka Adamczewska, InterRidge Office, University of Tokyo, Japan

OBJECTIVES

(1) To review recent progress in geological, geophysical, geochemical, and theoretical studies of hotspot mantle plumes and their interaction with mid-ocean ridges on global ocean basins;
(2) To identify key scientific issues that could be addressed in the coming years; and
(3) To discuss a general plan for more focused international collaboration in this important research field, especially multi-disciplinary experiments that cannot be achieved by single nations alone.

MEETING AGENDA

The meeting has two components:

- The first one and half days is a symposium to review the latest progress in international community on various ridge-hotspot systems globalwide (including oral and poster presentations); and
- The second one and half days is a workshop to identify pressing major issues on ridge-hotspot interaction and to discuss unique international, multi-disciplinary experiments to address these questions which otherwise cannot be done by single nations alone.

A more detailed agenda is now available from the IR website. The latest information workshop and registration details will be posted as they become available on the IR homepage

Questions about the meeting can be directed to the IR office: intridge@ori.u-tokyo.ac.jp

Upcoming Meetings and Workshops

3rd International Workshop on Scientific Use of Submarine Cables and Related Technologies

Komaba Campus - University of Tokyo, Japan
June 24-27, 2003,

http://www.eprc.eri.u-tokyo.ac.jp/KAIIKI/SSC03.html

Co-Chairs:
Junzo Kasahara, Earthquake Research Institute, University of Tokyo, Japan
Alan Chave, Woods Hole Oceanographic Institution, USA

Abstract Deadline: 31st January, 2003

Ridge related Scientific Topics will include:
- Mid-ocean ridge process studies
- Global geophysics

Technical Topics will include:
- Communication technologies
- Data management and archival technologies
- AUV/ROV
- Sensors

Full topic details can also be obtained from the link on "Meetings" page on the IR website.

7th International Conference on Gas Geochemistry (ICGG 7)

Freiberg, Germany,
22 - 26 September 2003

http://www.copernicus.org/ICGG7/

Organising Committee Chairman: J. Heinicke (SAW/TU-BA Freiberg)

Deadlines
- Notification of Interest: 15 February 2003
- Receipt of abstract: 30 April 2003
- Pre-registration and pre-reservation of accommodation: 1 June 2003

Aims & Scope
- Gas migration in terrestrial and marine environments
- Earth degassing (geogas) and its relation to seismicity and volcanic eruptions
- Rare gas application in hydrogeology and geothermal systems
- Application of isotope techniques for geogas/fluid transport processes
- Measurement and analytical techniques

Upcoming Meetings and Workshops

Russian-RIDGE Workshop on

Interdisciplinary Studies of Slow- and Ultra Slow-Spreading Ridges: From Mantle Melting to Biota Formation at Hydrothermal Vents.

Moscow, Russia
1-3, October 2003

Contact details:
Vernadsky Institute, Fax - (095) 938 2054,
e-mail: silantyev@geokhi.ru

For workshop programme see the IR website: http://www.intridge.org/moscow03.pdf

32nd International Geological Congress

Florence, Italy
20 – 28 August 2004

http://www.32igc.org/home.htm

Abstract Submission Deadline: January 10, 2004

Relevant sessions

T-18.04	Chemosynthetic communities through time
T-27.01	Igneous petrogenesis of ophiolites
T-27.02	Melt and fluid flow in evolution of oceanic lithosphere
T-27.03	Emplacement tectonics of ophiolites: structures and processes
T-27.04	Ophiolites and suture zones of the Tethysides
T-27.05	Record of oceanic rocks in Precambrian and Early Phanerozoic times
T-27.06	Ophiolites of the Circum-Pacific orogenic belts
G-12.03	Submarine hydrothermalism in the Mediterranean Sea
G-12.04	Hydrothermal mineralization on sedimented ridge

Post-congress field trip P07 - fluid expulsion and authigenic carbonates in miocene foredeep and satellite basins (Northern Apennines): http://www.32igc.org/circularN-field05_1.asp

The Organizing Committee will help individual scientists mainly from developing and East-European Countries to attend the Congress by partially subsidizing their expenses via the GeoHost Program (http://www.32igc.org/circular-gen07.htm).

Upcoming Meetings and Workshops

RIDGE 2000-InterRidge joint Theoretical Institute (R2K-IRTI): Interactions among Physical, Chemical, Biological, and Geological Processes in Backarc Spreading Systems

Jeju (Cheju) Island, Korea
24 - 28 May, 2004

http://www.intridge.org/babti04.htm

Organisers
Sang-Mook Lee (KORDI, Korea)
Kensaku Tamaki (Univ of Tokyo, ORI, Japan)
David Christie (Oregon State Univ, USA)
Patricia Fryer (Univ of Hawaii, USA)
Peter Herzig (Univ of Freiberg, Germany)
Daniel Desbruyeres (IFREMER, France)
Anna-Louise Reysenbach (Portland State Univ, USA)

The second IR theoretical Institute will take place on the Jeju (Cheju) Island, a shield volcanic island, located at the southern end of the Korean peninsular.

The IRTI will consist of 2 days of invited lectures and short courses (May 24-25), a one day field excursion (May 26th), and a 2 day workshop devoted to discussions by small groups (May 27-28).

There are 14 lectures planned by invited speakers doring the first two days.

All participants are encouraged to give poster presentations.

The latest information about this R2K-IRTI is posted on the IR website as it becomes available. You can also contact the local organiser, Dr Sanng-Mook Lee (smlee@kordi.re.kr) if you have further questions.

Please contact the IR office (intridge@ori.u-tokyo.ac.jp) to pre-register your interest in attending.

Your requests

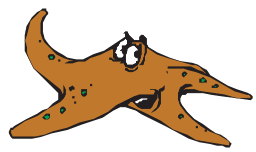
The InterRidge Wishhhhh List....

On suggestion of the IR Steering Committee, we have opened the InterRidge Wishhhhhh list to facilitate and poromote sample exchange between ridge scientists. Please submit requests for samples, to the IR Office. I would like to encourage all ridge scientist to check the Wishhhh list and share samples with your international colleagues. The success of this initiative is dependent on YOU! Below are three requests for samples. If you have such samples to share, please contact the appropriate scientists.

I wish I could get my hands on ....
Requested samples.....

Request for:
CHIMNEY SAMPLES

Samples of manganese encrusted chimneys as well as hydrothermal or hydrogenous ferromanganese samples and associated sediments collected from any other midoceanic ridge system".
Contact: Ranadip Banerjee
<banerjee@darya.nio.org> or
<banerjee@csnio.ren.nic.in>



SEARCH FOR GRAPHITE

Sediment trap deposits collected nearby vents, and/or grab samples of particulates from vents (0.0X to 1 gram quantities). Old collections are OK.
If such materials are available in your drawers, please contact: Jacques Jedwab
<jjedwab@ulb.ac.be>

ROCK SAMPLES
Rock samples from Laxmi Basin, Laxmi continental block or any protruding seamounts in eastern Arabian sea for physical/chemical studies
Contact: A. Shivaji (ashivaji@hotmail.com)

Wishhhhhh list ....

Would you like to get your hands on certain samples; be they rocks, crabs or tubeworms!
Send your 'wish list' to the InterRidge office and we will post it on the IR website and print it in the next issue of IR news.
Cooperation is the key to good science!

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